PROPOSED POST-OIL SPILL STUDY SITES, 1971-72

COMPUTER

4 SAUSALITO
4-1

5 FORT BAKER ~~SOUTH MUIR BEACH~~
5-1

6 STINSON BEACH
6-1

~~BOLINAS LAGOON~~

DUXBURY REEF
1 Area A
2 Area B
3 Area C
~~RCA REEF~~

DOUBLE POINT

~~BEAR VALLEY~~

7 DRAKES BEACH
7-1

8 CHIMNEY ROCK
8-1 subtidal

9 BIRD ROCK
9-1, 9-2, 9-3, 9-4

10 DOUBLE POINT
10-1, 10-2

G. Chan

POST-OIL SPILL STUDY SITES, 1971-72

Location	Area	Type of Transect	Oil?	Pre-Data	Random?	Organisms
DUXBURY REEF	AT-1	barren area	✓	1969	10 m^2	Teg
areas A, B, & C	AT-2	Δ 30 m from channel	✓	1969	10 m^2	Teg, mop
	AT-3	flood channel	no	1969	10 m^2	Teg, mop, Acan, A. fan
	AT-4	Agate to channel		1969	10 m^2	Teg, Acmaea, Lolli, Litt, Platyodon
	AT-5	Agate Island	✓	1969	10 m^2	Myt, Lolli, Acmaea, mop, Litt
	AT-6	9m x 4m		1969	4 m^2	Myt, Teg
(1-)	AT-7	cliff line	✓	1969	9 m^2	Teg, A. ele, Acm scabra
	AB-8	Berm 1	✓	1964	10 m^2	Litt, Acmaea, Bal
9	AB-9	Berm 2	✓	1964	10 m^2	Litt, Acmaea, Bal
10 ~~9~~	AB-10	Berms 3-10	✓	no	10 m^2	Litt, Acmaea, Bal
~~10~~	~~AS-11~~	~~stake #1~~	~~✓~~	~~1962~~	~~5 m^2~~	~~Myt, Lolli, Teg, A. ele, Acm spp.~~
~~[illegible]~~, Strong	~~AS-12~~	~~stake #2~~	~~✓~~	~~1962~~	~~2 m^2~~	~~Acm spp., mop~~
~~[illegible]~~ 11	~~AS-13~~	~~stake #3~~	~~✓~~		~~2 m^2~~	~~Myt, Acm spp.~~
Platy 12	~~AT-14~~	~~every 50 m~~		~~1969~~	~~m^2~~	~~Strongylocentrotus pur, Platyodon~~
	BT-1	25 m offshore	✓	1969	10 m^2	Teg, Bal, A. ele
	BT-2	Δ	✓	1969	10 m^2	Teg, Acan, Litt, Acm scabra
	BT-3	channel	no	1969	10 m^2	Teg, Acan, Platy
	BT-4	mesa base	no	1969	10 m^2	Teg, Acm spp, mop, A. ele
	BT-5	mesa	no	1969	10 m^2	Acm spp, Myt, Lolli, mop, Strongylo
(2-)	~~BT-6~~	~~entrance~~		~~1969~~	~~9 m^2~~	~~Teg, Acan, Bal, A. ele.~~
	~~BT-7~~	~~9 transects bet BT3 & BT4~~		~~1970~~	~~90 m^2~~	~~Teg, mop~~
	~~BB-8~~	Berm	✓	no		Litt, Acmaea, Bal
6	BR-9	ridge tidepools	✓	1959	2 m^2	Hermissenda smithii
7	BR-10	ridge	✓	1959	500 m	Lottia gigantea
~~8~~	~~BT-11~~	~~10m x 10m~~	~~no~~	~~1962~~		~~Cryptochiton stelleri~~
~~[illegible]~~, Strong	~~BT-12~~	~~every 50 m~~		~~no~~	~~m^2~~	~~Strongylocentrotus, Platyodon~~
8	CT-1	island	✓	1969	10 m^2	Teg, Acan, Acm scabra, mop
Platy 9	CT-2	anemone crevice	no	1969	10 m^2	Teg, Myt, A. fan, Bal, Litt
	~~CT-3~~	~~Bed I~~	~~✓~~	~~1968~~	~~10 m^2~~	~~Myt~~
3	CT-4	Bed IV	✓	1965	10 m^2	Myt, Lolli
	~~CT-4a~~	~~15' x 1' strips~~	~~✓~~	~~1957~~	~~3~~	~~Myt~~
4	CT-5	Pisaster corner	✓	1969	10 m^2	Myt, Pisaster, A. fan
5	CT-6	scraped patch	✓	1968	1 m^2	Acm. scabra
(3-) 6	CT-7	mushroom rock	✓	1969	1 m^2	Teg, Acan, Bal, Litt, Acm sc
	~~CT-8~~	~~Tony's pool~~	~~✓~~	~~1970~~	~~10 m^2~~	~~Myt, Lolli~~
	~~CT-9~~	~~sea urchins~~	~~no~~	~~1968~~	~~5 m^2~~	~~Strongylocentrotus~~
7	CT-10	10m X 20m	✓	1968		Lottia gigantea
8	CT-11	10 m crevice	✓	1968		A. xanthogrammica
9	CT-12	flood channel	no	1959	sieve	Saccoglossus sp.
~~10 [illegible]~~, Strong 10	CT-13	island	no	1967	subtidal	Haliotis rufescens
Platy 11	CT-14	shark's tooth rock	no	1967	subtidal	Haliotis rufescens
12	Bolinas Pt. subtidal					

G. Chan

POST-OIL SPILL STUDY SITES, 1971-72

Location	Area	Type of Transect	Oil?	Pre-Data	Random?	Organisms
DUXBURY REEF areas A, B, + C	AT-1	barren area	✓	1969	$10m^2$	Teg
	AT-2	Δ 30m from channel	✓	1969	$10m^2$	Teg, mop
	AT-3	flood channel	no	1969	$10m^2$	Teg, mop, Acan, A. fen
	AT-4	Agate to channel		1969	$10m^2$	Teg, Acmaea, Lolli, Litt, Platyodon
	AT-5	Agate Island	✓	1969	$10m^2$	Myt, Lolli, Acmaea, mop, Litt
	AT-6	9m x 4m		1969	$4m^2$	Myt, Teg
	AT-7	cliff line	✓	1969	$9m^2$	Teg, A. ele, Acm scabra
	AB-8	Berm 1	✓	1964	$10m^2$	Litt, Acmaea, Bal
	AB-9	Berm 2	✓	1964	$10m^2$	Litt, Acmaea, Bal
	AB-10	Berms 3-10	✓	no	$10m^2$	Litt, Acmaea, Bal
	AS-11	stake #1	✓	1962	$5m^2$	Myt, Lolli, Teg, A. ele Acm spp.
	AS-12	stake #2	✓	1962	$2m^2$	Acm spp, mop
	AS-13	stake #3	✓		$2m^2$	Myt, Acm spp
	AT-14	every 50m		1969	m^2	Strongylocentrotus pur, Platyodon
	BT-1	25m offshore	✓	1969	$10m^2$	Teg, Bal, A. ele
	BT-2	Δ	✓	1969	$10m^2$	Teg, Acan, Litt, Acm scabra
	BT-3	channel	no	1969	$10m^2$	Teg, Acan, Platy
	BT-4	mesa base	no	1969	$10m^2$	Teg, Acm spp, mop, A. ele
	BT-5	mesa	no	1969	$10m^2$	Acm spp, Myt, Lolli, mop, Strongylo
	BT-6	entrance		1969	$9m^2$	Teg, Acan, Bal, A. ele.
	BT-7	9 transects bet BT3 + BT4		1970	$90m^2$	Teg, mop
	BB-8	Berm	✓	no		Litt, Acmaea, Bal
	BR-9	ridge tidepools	✓	1959	$2m^2$	Hermissenda smithii
	BR-10	ridge	✓	1959	500m	Lottia gigantea
	BT-11	10m x 10m	no	1962		Cryptochiton stelleri
	BT-12	every 50m		no	m^2	Strongylocentrotus, Platyodon
	CT-1	island	✓	1969	$10m^2$	Teg, Acan, Acm scabra, mop
	CT-2	anemone crevice	no	1969	$10m^2$	Teg, Myt, A. fen, Bal, Litt
	CT-3	Bed I	✓	1968	$10m^2$	Myt
	CT-4	Bed IV	✓	1965	$10m^2$	Myt, Lolli
	CT-4a	15' x 1' strips	✓	1957	3	Myt
	CT-5	Pisaster corner	✓	1969	$10m^2$	Myt, Pisaster, A. fen
	CT-6	scraped patch	✓	1968	$1m^2$	Acm. scabra
	CT-7	mushroom rock	✓	1969	$1m^2$	Teg, Acan, Bal, Litt, Acm sc
	CT-8	Tony's pool	✓	1970	$10m^2$	Myt, Lolli
	CT-9	sea urchins	no	1968	$5m^2$	Strongylocentrotus
	CT-10	10m X 20m	✓	1968		Lottia gigantea
	CT-11	10m crevice	✓	1968		A. xanthogrammica
	CT-12	flood channel	no	1959	sieve	Saccoglossus sp.
	CT-13	island	no	1967	subtidal	Haliotis rufescens
	CT-14	shark's tooth rock	no	1967	subtidal	Haliotis rufescens

OIL SPILL STUDY LOG
FOR DUXBURY REEF
AREA A

	TRANSECT=	T1 (1-1)	T2 (1-2)	T3 (1-3)	T4 (1-4)	T5 (1-5)	T6 (1-6)	T7 (1-7)	B8 (1-8+9)	+ B9	B10 (1-10)	S11	S12	S13	T14 (1-11+12)
1971	January					✓ 4									
	February														
	March											✓ 4			
	April	✓ 4	✓ 1	✓ 2		✓		✓	✓ 4	✓ 4	✓ 4	✓✓			
	May											✓✓			
	June											✓			
	July	✓	✓	✓	X	X	✓ 4	✓	✓	✓	✓	✓		✓ N	✓
	August	✓	✓	✓	✓ N	✓		✓	✓	✓	✓		✓ 4		
	September														
	October														
	November														
	December														
1972	January														
	February														
	March														
	April														
	May														
	June														
	July														
	August														
	September														

OIL SPILL STUDY LOG

FOR DUXBURY REEF

AREA B

	TRANSECT=	2-1 T1	2-2 T2	2-3 T3	2-4 T4	2-5 T5	T6	T7	B8	2-6 R9	2-7 R10	T11	2-8+9 T12
1971	January												
	February												
	March												
	April	✓ 3	✓ 4	✓ N	✓ N	✓ N				✓			
	May												
	June												
	July	✓	✓	✓	✓					✓✓✓	✓ /	✓ N	✓
	August	✓	✓	✓	✓	✓				✓✓	✓	✓	
	September												
	October												
	November												
	December												
1972	January												
	February												
	March												
	April												
	May												
	June												
	July												
	August												
	September												

OIL SPILL STUDY LOG
FOR DUXBURY REEF
AREA C

~~3-10 ...~~

	TRANSECT=	3-1 T1	3-2 T2	T3	3-3 T4	T4a	3-4 T5	3-5 P6	3-6 M7	T8	T9	3-7 T10	3-8 T11	3-9 T12	T13	3-12 T14	Bolinas Pt. 3-10+11 T15
1971	January						✓										
	February						✓					✓	✓				
	March				✓	✓	✓	✓ 1			✓	✓	✓	✓			
	April	✓		✓ 2	✓			✓	✓✓		✓				✓ N		
	May			✓✓				✓✓	✓✓		✓✓						
	June			✓	✓			✓	✓		✓						
	July	✓	✓		✓	✓	✓	✓ N	✓			✓	✓	✓		✓	✓
	August	✓	✓					✓	✓				✓				
	September																
	October																
	November																
	December																
1972	January																
	February																
	March																
	April																
	May																
	June																
	July																
	August																
	September																

OIL SPILL STUDY LOG
FOR ALL non-Duxbury Reef SITES

Year	Month	SAUSALITO 4-1	FORT BAKER 5-1	STINSON BEACH 6-1	DRAKES BEACH 7-1	BOLINAS LAGOON	DOUBLE POINT 10-1, 10-2	BOLINAS POINT	CHIMNEY ROCK 8-1 Int.	CHIMNEY ROCK Sub.	BIRD ROCK 9-1, 9-2, 9-3 Int.	BIRD ROCK 9-4 Sub.
1971	January											
	February											
	March											
	April			✓	✓							
	May	✓										✓
	June											
	July		✓	✓								
	August				✓				✓		✓	✓
	September											
	October											
	November											
	December											
1972	January											
	February											
	March											
	April											
	May											
	June											
	July											
	August											
	September											

DUXBURY REEF

AREA A

N= no oil on transect
S= oil on transect

	Transect	Location	Area	Oil	Pachygrapsus crassipes, Petrolithes cinctipes, Pugettia producta	Tegula funebralis	Acanthina spirata	Mopalia muscosa	Cancer antennarius	Anthopleura xanthogrammica	Anthopleura elegantissima	Searlesia dira	Acmaea scabra	Acmaea scutum	Acmaea digitalis	Mytilus californianus	Pollicipes polymerus	Littorina scutulata	Pisaster ochraceus	Strongylocentrotus purpuratus	Balanus glandula	Other
1-1	AT-1	25 m offshore	$10m^2$	S	Area A	√	–															
1-2	AT-2	triangular	$10m^2$	S		+		–	–													
1-3	AT-3	flood channel	$10m^2$	N		+	–	–	–	–		–										√√ Platyodon cancellatus siphon holes
1-4	AT-4	Agate Is. chnl	$10m^2$	N		+	√	–	–				+			√	√√	+	–			
1-5	AT-5	Agate Is.	$10m^2$	S		√		√		–			√	√		√√√	√√		–	–		-Thais emarginata -Katharina tunicata -Acmaea pelta
1-6	AT-6	mussel beds	$4m^2$	S		yes										+						
1-7	AT-7	base/cliff	$9m^2$	S		+		–			+	–	–		–							
1-8	AB-8	berm	$10m^2$	S									√	–	√√			+			+	√Littorina planaxis
1-8	AB-9	berm	$10m^2$	S									√	–	√√			+			+	-Littorina planaxis
1-9	AB-10	berm	$10m^2$	S							–		√		+		√	+			+	-Littorina planaxis -Pachygrapsus crassipes
	AS-11	stake #1	~ $5m^2$	S		+	–	–			+		√		√	√	+	√			+	√Thais emarginata √Pagurus sp.
	AS-12	stake #2	~ $3m^2$	S		+		√			√		√√ spp.					√√			yes	√Pagurus
	AS-13	stake #3	~ $2m^2$	S									yes			yes						
	AT-14	every 50 m		S+N																√√		√√ Platyodon cancellatus siphon holes

1-10 crabs in all transects
urchins

Key for highest $\bar{X}\ m^2$ for past data

– = 0 < $\bar{X}$ < 1.0

, = 1 ≤ $\bar{X}$ ≤ 10.9

√, = 11 ≤ $\bar{X}$ ≤ 20.9

\+ = $\bar{X}$ ≥ 21.0

July 18, 1971
G. Chan

DUXBURY REEF

AREA B

N= no oil on transect
S= oil on transect

	Transect	Description	Area	Oil	Tegula funebralis	Anthopleura elegantissima	Balanus glandula	Acanthina spirata	Littorina scutulata	Mopalia muscosa	Acmaea pelta	Acmaea digitalis	Acmaea scabra	Platyodon cancellatus	Strongylocentrotus purpuratus	Other
2-1	BT-1	25 m offshore	$10m^2$	S	+	✓	✓									
2-2	BT-2	triangular	$10m^2$	S	+	✓		✓	+	−	−					
2-3	BT-3	flood channel	$10m^2$	N	+	−		✓		−				+		✓Pagurus samuelis, ✓Cancer antennarius
2-4	BT-4	base of mesa	$10m^2$	N	✓✓	+		✓		✓	✓	−	+			
2-5	BT-5	mesa	$10m^2$	N	✓		+		+	−	+spp				−	+Mytilus californianus, ✓Pollicipes polymerus, −Littorina planaxis
	BT-6	entrance	$10m^2$		+	✓✓		✓								
	BT-7	9 transects	$90m^2$							✓						
	BB-8	berm		S			+		+			✓	✓			
2-6	BR-9	ridge tidepools	$2m^2$	S					+							✓Herminea smithii
2-7	BR-10	ridge	500m	S												*✓✓ Lottia gigantea
	BT-11	sect. 1	10m X 10m	N												−Cryptochiton stelleri
	BT-12	every 50 m		S+N										✓✓	✓✓	

2-8 Area B crabs urchins

Key for highest $\bar{X}\cdot m^2$ for past data

− = $0 < \bar{X} \leq 1.0$

✓ = $1 \leq \bar{X} \leq 10.9$

✓✓ = $11 \leq \bar{X} \leq 20.9$

\+ = $\bar{X} \geq 21.0$

*total count, not $\bar{X}$ m^2

July 18, 1971
G. Chan

DUXBURY REEF

AREA C

N= no oil on transect
S= oil on transect

	Transect		Area	Oil	Tegula funebralis	Acanthina spirata	Acmaea scabra	Mopalia muscosa	Thais emarginata	Mytilus californianus	Pollicipes polymerus	Pisaster ochraceus	Anthopleura xanthogrammica	Balanus glandula	Littorina scutulata	Other
3-1	CT-1	island	$10m^2$	S	+	√√	√√	−	−							−Acmaea pelta
3-2	CT-2	anemones	$10m^2$	N	√	√				+		−		+	+	√Tegula brunnea √Anthopleura elegantissima
	CT-3	mussel bed I	$10m^2$	S				−	−	+	+		√			
3-3	CT-4	mussel bed IV	$11m^2$	S					+	+	+					
	CT-4a	mussel strips	(3)	S						+						
3-4	CT-5	seastar corner	$10m^2$	S						+		√	√√			
3-5	CT-6	limpet patch	$1m^2$	S			+									
3-6	CT-7	mushroom rock	$1m^2$	S	+	+	+							+	+	
	CT-8	Tony's pool	$10m^2$	S						+	+					
	CT-9	sea urchins alt.	$5m^2$	N												Strongylocentrotus purpuratus
3-7	CT-10	10m X 20m		S												*√√ Lottia gigantea
3-8	CT-11	10m crevice		S									*√√			
3-9	CT-12	flood channel	$1m^2$	N												+ Saccoglossus sp.
3-11	CT-13	subtidal		N												* √ Hermissenda crassicornis * √ Haliotis rufescens
3-11	CT-14	subtidal-shark's Bolinas Point end tooth		N												* √ Haliotis rufescens

3-10 Area C crabs, urchins

Key for highest $\bar{X}/m^2$ for past data

− = 0 ≤ $\bar{X}$ ≤ 1.0 √√ = 11 ≤ $\bar{X}$ ≤ 20.9

√ = 1 ≤ $\bar{X}$ ≤ 10.9 + = $\bar{X}$ ≥ 21.0

*total count, not $\bar{X}/m^2$

July 18, 1971
G. Chan

DATA SUMMARY for Study Site DUXBURY REEF Transect G. CHAN Oil? ____ n= mostly random p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

1969 SUMMER

Year / Date	Organisms	Tegula funebralis per	Anthopleura elegantissima per	Mopalia per	Hermit crabs	Strongylocentrotus purpuratus per	Littorina scutulata per	Barnacles	Acmaea spp. per	Acanthina spirata
Anne Hiaring 9m² Phyllospadix	X̄/unit	on P 59 6.6; not on P 384 42.7	25 2.8							
	size	per m²	per m²							
	change	8/9 8/9	8/9							
Cathy Sinclair 3 tidepools	X̄/unit	279 93.6	19 6.3	4 1.3	38 12.7		212 70.7	yes	126 42.0	
	size	per pool	per pool	per pool	per pool		per pool		per pool	
	change									
Bryan Gaddy 19 m² random both sides of line	X̄/unit					filled 408 21.5; empty 1492 78.5				
	size					per m²				
	change					1:4 ratio				
David Nills 10 m² random	X̄/unit									22 2.2
	size									per m²
	change									
Bob Johnson 40m² every 4th m	X̄/unit			filled 77 1.95 in; empty						
	size			2.0 4.0						
	change			1" to 2" 1.32≤M≤2.53						
Phil Davis 240 dm² 30 random dm² in 8 areas, 5m of line	X̄/unit						2274 9.5			
	size						per dm²			
	change									
Keith Parker 10 samples every 5 meters	X̄/unit						10 meters from splash zone		5.0/m²	
	size									
	change						flat		18.0/m²	
	X̄/unit						cliff face		61.0/m²	
	size						promontory		16.0/m²	
	change						exposed rock		8.0/m²	
	X̄/unit									
	size									
	change									
	X̄/unit									
	size									
	change									

DATA SUMMARY for Study Site DUXBURY Transect DX-AT-1 (~~1A~~) Oil? yes ++++ n= 10 m² p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Tegula funebralis per m²	Acanthina spirata per m²	Littorina scutulata per	Balanus glandula per	Acmaea spp per	Other per
1969	4/3	X̄/unit	3.9	0	0	0		
		Σ	39					
		size	10/10					
		change						
1969	(7/1)	X̄/unit	1.7	0				
		Σ	17					
		size	10/10					
		change						
1969	(8/1)	X̄/unit	7.1	0.1 Σ				
		Σ	71	1				
		size	10/10	1/10				
		change						
1971	1/23 oil covered ++++	X̄/unit	0 0	0				
		size						
		change						
1971	4/2	X̄/unit	0.2 Σ	–	0	B L D T		
	"	Σ	2					
		size	1/10					
		change						
1971	7/21	X̄/unit	0	0	9.94/dm², .04D	1.64/dm² 0.1D	.094/dm² .02D	.02L/dm² A.ele
	"	size						
		change			60 dm²	60 dm²	60 dm²	
1971	8/10	X̄/unit	0	0	12.1/dm²	No count	0.44/dm²	
	"	size						
		change			100 dm²	~~100 dm²~~	100 dm²	
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						

me

1-2

DATA SUMMARY for Study Site DUXBÛRY Transect DX-~~3A~~ AT-2 Oil? ~~no~~ a little mt. 1 n= 10m² p. 1

27, 28

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Tegula funebralis per m²	Cancer ~~[illegible]~~ antennarius per m²	Mopalia muscosa per m²	Pagurus spp. per	A. elegantissima	Acmaea spp. III per	Acanthina	Lit. pust per	Katharina	
1969	6/3	X̄/unit	37.8									
		Σ	378	0	0	0		0			0	
		size	10/10									
		change										
1969	(7/1)	X̄/unit	29.5									
		Σ	295									
		size	10/10	0								
		change										
1969	(8/1)	X̄/unit	58.9	0.1								
		Σ	589	1	0							
		size	10/10	1/10								
		change										
(1971)	4/2	X̄/unit	17.8		0.1							
		Σ	178		1	0		0			0	
+ ~~none~~ a little		size	10/10		1/10							
		change										
1971	7/22	X̄/unit	60.2			1.2	0.8	2.7	0.3	55.0	2.5L 6.0D	mc
		Σ	602	0	0	12	8	27	3	550±	25L 60D	50 [illegible] (1 [illegible])
+		size										
		change										
1971	8/9	X̄/unit	56.2		0.1	1.1	0.8	2.0	0.2	(no count)		
+		Σ	562	0	1	11	8	20	2			
		size										
		change										
		X̄/unit										
		size										
		change										
		X̄/unit										
		size										
		change										
		X̄/unit										
		size										
		change										
		X̄/unit										
		size										
		change										

NO COUNT present [illegible]

DATA SUMMARY for Study Site DUXBURY Transect DX- ~~3A~~ AT-3 Oil? ~~no~~ a little X1 X2 X10 n= 10 m² p. 1

1-3

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Tegula funebralis per m²	Platyodon cancellatus siphon holes per m²	Acanthina spirata per m²	Cancer antennarius per m²	Mopalia muscosa per	Anthopleura xanthogrammica per	Searlesia dira per	
1969	6/3	X̄/unit	39.1	2.6	0	0	0	0	0	
		Σ	391	26						
		size	10/10	1/10						
		change								
1969	(7/1)	X̄/unit	17.2	2.6	0.2	0	0	0	0	
		Σ	172	26	2					
		size	10/10	1/10	2/10					
		change								
1969	(8/1)	X̄/unit	23.1	2.6	0	0.1	0	0	0	
		Σ	231	26		1				
		size	10/10	1/10		1/10				
		change								
1971	4/2	X̄/unit	31.6	20.0	0.5	0	0.5	0.1	0.5	
++ ~~n...~~ 17		Σ	316	200	5		5	1	5	
		size	10/10	7/10	3/10		4/10	1/10	3/10	
Σ 532		change								
1971	7/23	X̄/unit	72.0	4.3	0.7	PAGURUS SPP 1.3	0.1		THAIS / ACM	MC: 1 Cancer anth. 2 Nemi...
++		Σ	720	43	7	13	1	0	11 / 16	
		size								
Σ 814		change								
1971	8/9	X̄/unit	106.9	4.3	1.9	0.9			0.7	1 DEAD Nemi
++		Σ	1,069	43	19	9	0	0	no count? 7	
		size								
Σ 1148		change								
		X̄/unit								
		size								
		change								
		X̄/unit								
		size								
		change								
		X̄/unit								
		size								
		change								
		X̄/unit								
		size								
		change								

1-4

DATA SUMMARY for Study Site DUXBURY Transect DX-~~4A~~ AT-4 Oil? no n= 10m² p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year Date	Organisms	*Tegula funebralis* per m²	*Acanthina spirata* per m²	[illegible] per m²	*Acmaea scabra* per m²	~~*Mytilus californianus*~~ / *Pollicipes polymerus* per m²	*Littorina scutulata* per m²	*Pisaster ochraceus*
1969 6/3	X̄/unit	19.9 ~~199~~	2.6 ~~26~~	0.3 ~~3~~	85.0 ~~850~~	1.2 ; 20.0	~~150.0~~ ~~1500~~ X̄ of 15.0/dm²	0.1
129.1/m² + (15/dm² Litt for 1m²)	Σ	199	26	3	850	12 ; 200	1500	1
Σ 2791	size	10/10	3/10	3/10	5/10	1/10 ; 7/10	1/10	adj [illegible]
~~Σ 446~~	change							
1969 (7/1)	X̄/unit	20.3 ~~203~~	1.4 ~~14~~		82.0 ~~820~~	~~[illegible]~~ 0 ; 20.0	~~150.8~~ X̄ of ~~15.0~~/dm²	
123.7/m² + Litt	Σ	203	14		820	200	1500	
Σ 2737	size	10/10	4/10	0	5/10	2/10	1/10	
~~Σ 372~~	change							
1969 (8/1)	X̄/unit	27.2 ~~272~~	0.1 ~~1~~	0.1 ~~1~~	82.0 ~~820~~	0 ; 20.0	~~150.0~~ X̄ of 15/dm² ~~1500~~	0.2
128.7/m² + Litt	Σ	272	1	1	820	200	1500	2
Σ 2787	size	10/10	1/10	1/10	5/10	2/10	1/10	2/10
	change						ALSO 1 Cancer antennarius	
1971 8/9	X̄/unit	3.7	PAGURUS 2.4	SEARLESIA 0.7	0	0	0	
N	Σ	37	24	7				
Σ 68	size	9/10	10/10	5/10				
	change							
	X̄/unit							
	size							
	change							
	X̄/unit							
	size							
	change							
	X̄/unit							
	size							
	change							
	X̄/unit							
	size							
	change							
	X̄/unit							
	size							
	change							
	X̄/unit							
	size							
	change							

DATA SUMMARY for Study Site DUXBURY Transect ~~DX-3A~~ AT-5 Oil? yes +++ n= 10m² p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	*Mytilus californianus* (per)	*Pollicipes polymerus*	*Tegula funebralis* (per)	*Mopalia muscosa* + holes	*Acmaea scabra* (per)	*Acmaea scutum*	*Anthopleura xanthogrammica* (per)		*Acmaea pelta* (per)	*Katharina tunicata*	*Pisaster ochraceus* (per)	*Strongylocentrotus purpuratus*	*Thais marginata*
1969	6/3	X̄/unit	11.4	8.9	11.0	0.1	11.0	7.2					0.1		
		Σ	114	89	110	1+many	110	72					1		
		size	10/10	5/10	5/10	3/10	4/10	3/10					1/10		
Σ496		change													
1969	(7/1)	X̄/unit	8.2	8.5	9.5	0.3	8.5	2.2							
		Σ	82	85	95	3+many	85	22							
		size	7/10	5/10	8/10	5/10	4/10	3/10							
Σ372		change													
1969	(8/1)	X̄/unit	8.2	8.5	10.8	0.2	7.0	1.8					0.1		
		Σ	82	85	108	2+many	70	18					1		
		size	7/10	5/10	7/10	4/10	4/10	3/10					1/10		
Σ366		change													
1971	1/23	X̄/unit	13.0	3.3	0.1	1.4	1.7								
		Σ	130	33	1	14	17								
all + globules of oil		size	6/10	4/10	1/10	7/10	5/10								
Σ196		change													
1971	4/2	X̄/unit	13.5	18.0		2.5	1.5	0.1	0.5		0.1	0.1		0.1	0.1
		Σ	135	180		25	15	1	5		1	1		1	1
all + globules of oil		size	5/10	2/10	0	10/10	7/10	1/10	3/10		1/10	1/10		1/10	1/10
Σ365 oil on some organisms		change													
1971	8/9	X̄/unit	11.7	29.2	1.1	2.7	22.0 PP				← ~~app~~ LEPTAST	0.1	0.1		
all +		Σ	117	292	11	27	220				4	1	1		
		size	2/10	2/10	6/10	10/10	10/10				3/10	1/10	1/10		
Σ673		change									34mm				
		X̄/unit													
		size													
		change													
		X̄/unit													
		size													
		change													
		X̄/unit													
		size													
		change													
		X̄/unit													
		size													
		change													

☆ Balanus

DATA SUMMARY for Study Site DUXBURY REEF Transect AT-6 Oil? yes ++++ "Separate" "Random" n= 4m² p. 1 1-6

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date		Mytilus ~~californianus~~ californianus (per m²)	Tegula funebralis (per)	Pollicipes polymerus (per)	Balanus (per dm²)	Acmaea (per dm²)	Littorina (per)
1969	5/17	X̄/unit	288.3	only noted, no count	present	present	present	present
		Σ	1155					
n=4m²		size						
		change						
1969	5/30	X̄/unit	399.5	"				
		Σ	1598					
n=4m²		size	1m² bed 25-31mm					
		change				12dm²		
above combined		X̄/unit	344.1			7/22/71 17.2L, 64.2D		
n=8m²		Σ	2753			206L, 771D		
		size						
		change				~~8dm²~~	12dm²	
1971	7/22 ++++	X̄/unit	790.3L, 4.7D	0	480.3L	~~22.2L~~	Digitalis other	
		Σ	2371L, 14D		1441L	~~94.2D~~ (~~30.2D~~)	~~2~~ 86L 5L	
n=3m²	+ +	size	60-70mm		40-60mm	3-5mm		
		change				crumbly shells		
	8/9	X̄/unit	604.4L, 2.0D					
++++		Σ	6044L, 20D	0	4313L, 6D	(no count)	994L approx	233L
n=10m²		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						

Margin note beside 8/9 row: Dead 3 Tegula, 23 Lucs., 4 Acmaea, 3 Tegula, 3 Pisaster, 1 Tegula

1-7

DATA SUMMARY for Study Site DUXBURY Transect DX-~~7A~~ AT-7 Oil? ~~[illegible]~~ +++ a little oil n= 9m² p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Tegula funebralis per m²	Anthopleura elegantissima per m²	Mopalia muscosa per m²	Acmaea digitalis + A. scabra per m²	Searlesia dira per m²	~~Tegula [illegible]~~ per m²
1969 $\bar{X}$= 59.1	5/17	$\bar{X}$/unit Σ	42.0 318	16 144	0.8 7	0.1 1	0.2 2	
		size	9/9	6/9	5/9	1/9 ~~4/9~~	4/9	0
		change						
1969 $\bar{X}$= 51.6 Σ 428	5/30	$\bar{X}$/unit	30.6 275	16 144	0.9 8	0.1 1		
		size	9/9	4/9	6/9	1/9 ~~4/9~~	0	0/9 ~~[illegible]~~
		change						
1969 $\bar{X}$= 63.2	6/27	$\bar{X}$/unit	47 423	posted 144 ~~16 144~~ ~~[illegible]~~	0.2 2			
		size	9/9	6/9 ~~[illegible]~~	2/9	0	0	0
		change						
+++ 1971 $\bar{X}$= 47.2 thin ~~little oil~~ coating in all m² Σ 426	4/2	$\bar{X}$/unit	17.3 156	29.5 266		0.3 3	0.1 1	~~426~~
		size	9/9	1" closed 9/9	0	0 2/9	1/9	0
		change						PAGUROS spp
1971 +++ $\bar{X}$= 62.0 Σ 559	7/23	$\bar{X}$/unit Σ	53.0 470	7.2 65	0.3 3	0.7 7 opp	ACANTHINA 0.1 1	0.7 6 (10% shell)
		size		$\bar{X}$=1.8cm		4/9		3/9
		change		posted 65				
1971 +++ $\bar{X}$= 67.6 Σ 613	8/9	$\bar{X}$/unit Σ	55.1 496	7.2 65 ~~[illegible]~~	~~[illegible]~~ 0.3 3	4.2 38	OTHER 0.2 1 Cancer 1 Pachy 4 Crepidula	0.6 5 (20% shell)
		size	9/9	~~[illegible]~~	3/9 ~~[illegible]~~	8/9		5/9
		change		desiccating				
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						

chart data

DATA SUMMARY for Study Site DUXBURY Transect AB-8+9 Oil? ____ n= ____ p. ____

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Acm. digi. scab. + Litt. planaxis per	Acm. digi. + scab. only per	Litt. plan. W per	Acm. digi. + scab. W per	L S, ST, T per	D S, ST, T per
1964	11/19	$\bar{X}$/unit	29.9	28.7	Σ only 24	Σ only 574		
		size						
		change						
1968	4/27	$\bar{X}$/unit	29.5	28.5	19	570		
		size						
		change						
1969	5/22	$\bar{X}$/unit	31.0	30.0	19	600		
		size						
		change						
1970	3/10	$\bar{X}$/unit	29.9	29.0	18	580		
		size			~~17~~			
		change						
1970	4/23	$\bar{X}$/unit	29.4	28.6	~~18~~ 17 18 12/19	571		
		size						
		change						
1971	4/2	$\bar{X}$/unit	16.1L 2.8DS 15% D	16.0L	2 (15)	320L 55DS 15%DS		
		size						
		change						
1971	7/20	$\bar{X}$/unit	12.7L 1.9DS 13% D	12.4L	5	248L ✓ 38DS 13%DS		
		size						
		change						
1971	8/9	$\bar{X}$/unit	19.7 1.5DS 6% D	19.7L	1	393L 31 ~~27~~ DS 7%DS		
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						

1-8 + 9

+++

DATA SUMMARY for Study Site DUXBURY REEF Transect A38+9 Oil? yes n= 20m² p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	*Littorina planaxis* per m²	*Acmaea digitalis* ~~(Acm. persona)~~ per m	*Acm. scabra* / *Acm. pelta* ~~(Acm. pelta)~~ per	*Littorina scutulata* per	*Balanus glandula* per	OTHER per (PACHY)
1964	11/19	X̄/unit	1.2	18.2	10.5	21.78 very ~~few~~ numerous	45.49	69.70
		Σ	24L	20 364L + 574	210L	no count ☆	☆	☆
		size						
		change						
1968 -0.9	4/21	X̄/unit	1.0	17.5	11.0	"	"	☆
		Σ	19L	350L + 570	220L			
		size						
		change						
1969 -0.1	5/22	X̄/unit	1.0	18.8	11.3	"	"	☆
		Σ	19L	375L + 600	225L			
		size						
		change						
1970 0.1	3/10	X̄/unit	0.9	18.0	11.0	"	"	☆
		Σ	18L	360L + 580	220L			
		size						
		change						
1970 -1.1	4/23	X̄/unit	0.9	17.8	10.8	"	"	☆
		Σ	17L	355L + 571	216L			
		size						
		change						
1970 -0.7	12/9	X̄/unit	0.9	(no count) ☆	(no count) "	"	"	many Pachygrapsus
		Σ	18L					200 per hole
		size						
		change						
1971	4/2	X̄/unit	0.1	11.5L 2.3DS	4.6L 0.5DS	"	~~10D~~ ~~560L 28D~~	
		Σ	2(1S)	230L, 45DS (ones) 25% S	91L, 10DS (ones) 25% S	2L		
		size						
		change						
1971	7/20 + 7/21	X̄/unit	0.3	10.5L 1.2D	3.0L 1.0D	3.34/dm²	6.9L/dm²	1L, 1D Pagurus; 3L Hemigrapsus; 4 Orch
		Σ	5L	209L 24D (13S, 25T) (12S, 8ST, 6T)	61L 21D (18S, 25T, 2T)	2L 0.03D/dm²	1.1D/dm²	16 A. ele NO; 1 PACHY
		size						
		change						
1971	8/9	X̄/unit	0.05	17.8L 1.4D	1.9L, 0.1D	118.7L 1.6D	(no count)	2L Pachy; 2L Hemi
		Σ	1L	356L, 21DS (20S) 25%, 02T +8 ones	38L, 2D (1ST)	1L 2373L, 32D (645, 1951, 331T) (1T)		16 A. ele NO
		size						
		change						
1971	10/6	X̄/unit		digit. scabra?			Balanus 200 molecules	35L Pachy (21T); 1D Pachy; Pagurus
		size						
		change						

1-10 COMPUTER POST

DATA SUMMARY for Study Site DUXBURY REEF Transect ~~AB-~~ 100il? yes n= 10 m² separate p. 1 1-10

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Acmaea digitalis per	Acmaea scabra per	Littorina scutulata per	Balanus glandula per	Pollicipes polymerus per	A. elegantissima	Tect. planaxis per	OTHER
1971	4/27	X̄/unit	58.7L 21.6DS	4.9L 0.7DS	230.4 20.3D	36.4/dm² 68.4/dm²	10.5	0.5	0.4	0.1
		Σ	587L, 216DS	49L 7DS	2,304L 203D	510L 558D	105L	5L	4L	1 Pachy
-1.5	10m²	size	(46S,1T)	(4S)	(4S,153T)	n=14 (930S)		OMIT		
PUNCH CARDS 7/4/71		change								
1971	7/21 + 7/22	X̄/unit	44.6L 12.3DS	7.1L 0.2DS	13.34/dm² 0.01D/dm²	24.3L/dm² 4.5D/dm²				2 Pachy
		Σ	401L, 11LDS	64L 2DS	119.4L 0.1D	218.5L 40.3D	83L, 1D (3S)	7L	0	34 Tegula funebralis, 3 Acmaea
-1.2	9m²	size	(48S,285T,24T)	(5S,2ST,3T)	(6.6T)	(11.1S)				
-1.0		change			~~n=100~~ n=90	n=100				
1971	8/7 + 8/8	X̄/unit	49.0L 13.0DS	7.2L 0.2DS	1326.4L 1.1DS	24.3L 4.5DS				1 Pachy
	9m²	Σ	441L, 117DS	65L 2DS	11,938 10DS	(same)	96L, 1D (3S)	7L	0	53 Tegula funebralis, 4 Acmaea
-1.0		size	(36S,265T,39T)	(3S,15T,3T)	(6.6T)					
0.7		change				n=100				
		X̄/unit								
		size								
		change								
		X̄/unit								
		size								
		change								
		X̄/unit								
		size								
		change								
		X̄/unit								
		size								
		change								
		X̄/unit								
		size								
		change								
		X̄/unit								
		size								
		change								
		X̄/unit								
		size								
		change								

1-1 and 1-2 m² every 25 m

DATA SUMMARY for Study Site DUXBURY REEF Transect AT-14 Oil? ____ n= 50 m p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Strongylocentrotus purpuratus 1-11 per m²	Platyodon cancellatus 1-12 per m²	per	per	per	per
1971 n=8	7/20 + 7/21	$\bar{X}$/unit	2.7	11.8L 5.6D				
		Σ	8	59L, 28D				
		size	n=3 N.	n=5 ++ 3N, 2+				
	-1,1,-1.2	change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
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		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						

DATA SUMMARY for Study Site DUXBURY REEF Transect BT-1 Oil? yes n= 10 m² p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Tegula funebralis per	Anthopleura elegantissima per	Balanus glandula per	OTHER per	per	per
1969	6/4	X̄/unit	18.3			clean Tegs, no sulfur on shells, ulva & enteromorpha		
		Σ	183	present	present			
		size	8+yrs 9/10					
		change						
1969	(7/1)	X̄/unit	18.7					
		Σ	187					
		size	10/10					
		change						
1969	(8/1)	X̄/unit	37.7					
		Σ	377					
		size	3 to 21 yr 10/10					
		change						
1971	4/2 +++	X̄/unit	23.4	4.2	4.3	globules of oil on T, -4, no oil on organisms		
		Σ	234	42	43			
		size	2 to 21 yr 9/10					
Σ 319		change	most 5 yr 3=9 yr					
1971	7/23 N	X̄/unit	14.8	1.9		1 Thais?		
		Σ	148	19	?			
		size	7/10	6/10				
Σ 168		change						
1971	8/9 N	X̄/unit	25.0	14.1		1 Acanthina		
		Σ	250	141	?			
		size						
Σ 392		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						

2-2
++++ (10)

DATA SUMMARY for Study Site DUXBURY REEF Transect BT-2 Oil? yes n= 10 m² p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Tegula funebralis (per)	Acanthina spirata (per)	Acm. scabra (per)	Acm. digitalis	Littorina scutulata (per)	Mopalia muscosa (per)	Acm. pelta	Antho. elegant. (per)
1969	4/4	X̄/unit	41.8	2.5	0.5	0.1	500 traced on 5/km²			
		Σ	418	25	5	1				
		size	≥50% 10/10	2/10	2/10	1/10				
Σ 949		change	less than 1 yr. old							
1969	(7/1)	X̄/unit	8.7	2.2	0.3			0.1	0.1	
		Σ	87	22 (32 corrected)	3		500	1	1	
		size	10/10	5/10	2/10			1/10	1/10	
Σ 617		change								
1969	(8/1) ++++	X̄/unit	57.9	8.6	0.5			0.1	0.1	
		Σ	579	86	5		500	1	1	
		size	10/10	7/10	3/10			1/10	1/10	
Σ 1172		change								
1971	4/15 ++++	X̄/unit	8.1	3.0	11.0					1.8
		Σ	81	30	110		NONE	0	0	18
		size	4/10	7/10	10/10					1/10
Σ 239		change								2-13mm
1971	7/22 ++++	X̄/unit	19.4	3.2	~~[illegible]~~ 17.5					0.8
		Σ	194	32	175		0	0	0	8 1 mg[illegible]
		size	2cm	2-3cm	1-3cm					1-2½cm
Σ 410		change								
1971	8/9 ++++	X̄/unit	10.3	6.1	15.5					2.5
		Σ	103	61	155		0	0	0	25 0
		size								
Σ ~~354~~ 344		change								
		X̄/unit								
		size								
		change								
		X̄/unit								
		size								
		change								
		X̄/unit								
		size								
		change								
		X̄/unit								
		size								
		change								

DATA SUMMARY for Study Site DUXBURY REEF Transect BT-3 Oil? no n= 10m² p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Tegula funebralis (per)	Platyodon cancellatus (per)	A. elegantissima (per)	Cancer antennarius	Acanthina spirata (per)	Mopalia muscosa	Pagurus (per)	Cancer spp.	Thais (per)	Pisaster ochraceus
1969	6/4	X̄/unit	55.4	present	0.1	0.1						
		Σ	554		1	1						
		size	10/10			large						
Σ 556		change										
1969	(7/1)	X̄/unit	39.7				0.5					
		Σ	397				5					
		size	10/10				1/10					
Σ 402		change										
1969	(8/1)	X̄/unit	53.0				1.6					
		Σ	530				16					
		size	10/10				4/10					
Σ 546		change										
1971	4/15	X̄/unit	26.9				1.2					
		Σ	269	258			12	3	3			
		size	1"=8 tyns 10/10	8/10			3/10	3/10 1½"-2"	1/10			
Σ 287+258		change										
1971	7/21	X̄/unit	42.7	present								
		Σ	427		5		12		1	12	3	
		size										
Σ 460+?		change										
1971	8/9	X̄/unit	11.8									
		Σ	118	154	0		10	3	15	0	0	1
		size										
Σ 147+154?		change										
		X̄/unit										
		size										
		change										
		X̄/unit										
		size										
		change										
		X̄/unit										
		size										
		change										
		X̄/unit										
		size										
		change										

DATA SUMMARY for Study Site DUXBURY REEF Transect BT-4 Oil? no n= 10m² p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Tegula funebralis per	Acanthina spirata per	Anthopleura elegantissima per	Mopalia per	Pisaster	Acmaea pelta per	Acmaea digitalis	Acmaea scabra per	OTHER
1969	4/4	X̄/unit	15.7	12.2		1.8	0.1	0.8	0.1		
		Σ	157	122	many	18	1 Lept	8	1		
		size	10/10	6/10	10/10	8/10		1/10			
Σ 307+AEL		change									
1969	(7/1)	X̄/unit	13.7	6.5		0.7		1.0	0.1		
		Σ	137	65	many	7		10	1		
		size	10/10	8/10		4/10		1/10			
Σ 220+AEL		change									
1969	(8/1)	X̄/unit	17.3	7.9		1.0		0.3	0.1		
		Σ	173	79	many	10		3	1		
		size	10/10	7/10		4/10		1/10			
Σ 226+AEL		change									
1971	4/15	X̄/unit	14.2			2.3		3.3		39.5	2
		Σ	142	0	149	23		33		395	
		size	10/10		7/10 89 ≤ 26mm	8/10		4/10		10/10	
Σ 742		change									
1971	7/22	X̄/unit	52.0	1.1	20.7			A. SPP			
		Σ	520	11	207	0		~~108~~ 101			5 Teg brunnea 1 Mytilus
		size	9/10	6/10	7/10			10/10			
Σ 845		change									
1971	8/9	X̄/unit	24.3	0.2	35.2	1.8	0.1				
		Σ	243	2	352	18	1 Pis	605			
		size	10/10		8/10	9/10		10/10			
Σ 1221		change									
		X̄/unit									
		size									
		change									
		X̄/unit									
		size									
		change									
		X̄/unit									
		size									
		change									
		X̄/unit									
		size									
		change									

DATA SUMMARY for Study Site DUXBURY REEF Transect BT-5 Oil? no n= 10 m² p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Mytilus californianus per	Anemone spp. per	T. scutulata per	Balanus glandula	Strongylocentrotus purpuratus per	[illegible]	Pollicipes polymerus per	OTHER per
1969	4/4	X̄/unit Σ	1084	3550 (~~3250~~)	5/dm² 500	many	9 +30 holes	2	38	11 eg. funebralis, 32 [illegible] planaxis
		size	25-38 mm 10/10	10/10	1/10		2/10	2/10	1/10	
Σ 5187 (~~4887~~) +Bal		change								
1969	(7/1)	X̄/unit Σ	612	4550	~~500~~	many	2	4	28	
		size	10/10	10/10	4/10		2/10	3/10	2/10	
Σ 5696+Bal		change								
1969	(8/1)	X̄/unit Σ	619	4550 (~~4400~~)	500	many	7	5	28	127 eg. funebralis
		size	10/10	10/10	1/10		2/10	5/10	2/10	
Σ 5721 (~~5571~~) +Bal		change								
1971 (circled)	4/15 N	X̄/unit Σ	1155	1508	0	many	11	6	5	
		size					3/10	4/10	3/10	
Σ 2685 +Bal		change								
1971	8/9	X̄/unit Σ	513	3338	0	100 dm² 768L 158D (circled)	8	0	10	
		size					2/10		4/10	
Σ 3869+Bal		change								
		X̄/unit								
		size								
		change								
		X̄/unit								
		size								
		change								
		X̄/unit								
		size								
		change								
		X̄/unit								
		size								
		change								
		X̄/unit								
		size								
		change								

July incomplete

DO NOT INCLUDE?

DATA SUMMARY for Study Site DOXBURY REEF Transect BT-6 Oil? ____ n= 9m² p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Tegula funebralis per m²	Anthopleura elegantissima per m²	Acanthina spirata per m²	per	per	per
1969	5/17	$\bar{X}$/unit	57.4	12.9	4.8			
		S	517	116	43			
		size						
Σ 676		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						

DO NOT INCLUDE?

DATA SUMMARY for Study Site DUXBURY REEF Transect BT-7 Oil? ____ n= 90m² p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

all $\overline{X}$/m² data

between BT3 + BT4 9 transects of 10m² each

Year	Date	Organisms	Tegula funebralis per m²	Megathura crenulata per m²	per	per	per	per
1970	9/10 transect #1	$\overline{X}$/unit	59.4/m²	1.0 24.0 holes				
		size	3.5 yrs					
0.1 @ 7:24 AM		change						
	#2	$\overline{X}$/unit	39.8	0.2 12.0 holes				
		size	2.7 yrs					
		change						
	#3	$\overline{X}$/unit	37.9	0.2 5.0 holes				
		size	4 yrs					
		change						
	#4	$\overline{X}$/unit	39.8	0.2 5.0 holes				
		size	2.4 yrs					
		change						
	#5	$\overline{X}$/unit	37.2	1.0 2.5 holes				
		size	4.5 yrs					
		change						
	#6	$\overline{X}$/unit	38.6	0.9 2.5 holes				
		size	3.0 yrs					
		change						
	#7	$\overline{X}$/unit	58.0	2.0 9.0 holes				
		size	5 yrs					
		change						
	#8	$\overline{X}$/unit	28.0	0.7 3.0 holes				
		size	4.9 yrs					
		change						
	#9	$\overline{X}$/unit	38.8	0.2 4.7 holes				
		size	3.1 yrs					
		change						
overall $\overline{X}$/m²		$\overline{X}$/unit	41.9/m²	0.7/m²				
Σ		Σ	377.5 33.1	6.4 67.7				
		size	3.7 yrs	7.5 holes				
		change						

DO NOT INCLUDE

DATA SUMMARY for Study Site DUXBURY REEF Transect BB-8 Oil? ____ n= Bump. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year Date	Organisms					
	per	per	per	per	per	per
X̄/unit						
size						
change						
X̄/unit						
size						
change						
X̄/unit						
size						
change						
X̄/unit						
size						
change						
X̄/unit						
size						
change						
X̄/unit						
size						
change						
X̄/unit						
size						
change						
X̄/unit						
size						
change						
X̄/unit						
size						
change						
X̄/unit						
size						
change						

2-6 | 2 tidepools ~1m² each | OM-T

DATA SUMMARY for Study Site DUXBURY REEF Transect BR-9 Oil? ✓ n= 2m² p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year Date	Organisms	Henricia smithii per m²	Littorina scutulata per m²	per	per	per	per
1959 2/11	X̄/unit	6.0					
	Σ	12	yes				
-0.5	size	1/2"					
L. Andrews	change						
1964 11/19	X̄/unit	5.0					
	Σ	10	yes				
	size						
T. Gosliner	change	-Σ2					
1965 6/29	X̄/unit	5.5					
	Σ	11	yes				
	size						
	change	Σ+1					
+ 1971 3/25 (circled)	X̄/unit	4.0					
	Σ	8	many				
	size						
	change	-Σ3					
+ 1971 7/9	X̄/unit	3.5					
	Σ	7	many				
	size						
	change	-Σ1					
+ 1971 7/20	X̄/unit	6 pool #1	β ↓				
	Σ						
-1.1 @ 5:11 AM	size	0 pool #2 7.5 cm					
	change						
+ 1971 7/22	X̄/unit		pool #1 1,973L, 163D				
	Σ	4 pool #1	pool #2-1 = 6.8/dm²	} 2490L/			
-0.1 @ 7:12 AM	size	0 pool #2	2-2 = 18.1/dm² 3-5 mm	/20 dm²			
	change						
+ 1971 8/9	X̄/unit		(no count)				
	Σ	0	β				
-0.2 @ 7:54 AM	size						
	change						
+ 1971 8/10	X̄/unit		(no count)				
	Σ	3 pool #1	β				
0.5 @ 8:36 AM	size	0 pool #2					
	change						
	X̄/unit						
	size						
	change						

omit 2-7 ~~2-7~~ ~~2-9~~

DATA SUMMARY for Study Site DUXBURY REEF Transect BR-10 Oil? ✓ + n= 500± ridge mp. ___

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Lottia gigantea per	per	per	per	per	per
~~1962~~ 1959	2/11	X̄/unit						
		Σ	18					
-0.5		size						
		change						
1962	5/30	X̄/unit						
-0.9		Σ	21					
@ 4:38PM		size						
		change	+3					
1965	4/29	X̄/unit						
		Σ	17					
		size						
		change	-4					
	7/21	X̄/unit						
1971 +		Σ	3L(LS) 0D					
no obvious scars		size						
large areas of ridge had oil		change	1¼"-1¾"					
1971 +	8/9	X̄/unit						
		Σ	9(3S) 0D					
-0.2 clear		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						

DATA SUMMARY for Study Site DUXBURY REEF Transect BT-11 Oil? no n= 10m x 10m p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Cryptochiton stelleri per	per	per	per	per	per
1959	2/11	$\bar{X}$/unit Σ	2					
		size						
		change						
1964	11/19	$\bar{X}$/unit Σ	4					
		size						
		change						
1965	4/29	$\bar{X}$/unit Σ	4					
		size						
		change						
1971	7/23	$\bar{X}$/unit Σ	0					
N		size						
-0.8 foggy		change						
1971	8/10	$\bar{X}$/unit Σ	0					
N		size						
0.5 clean		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						

~~2-6~~ ~~2-8~~ 2-8+9

DATA SUMMARY for Study Site DUXBURY REEF Transect BT-12 Oil? ~~#7~~ n= p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Strongylocentrotus purpuratus	Platyodon cancellatus				
			per m²	per m²	per	per	per	per
1971		$\bar{X}$/unit	7.2L	3.0L 0.6D				
	n = 16 m²	~~[illegible]~~ Σ	43	30L 6D				
	-1,0, -0.8	size	n = 6N	n = 10 ++ 5N, 5+				
		change	mussels taking over old holes					
		$\bar{X}$/unit	more holes than occupied					
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						

DATA SUMMARY for Study Site DUXBURY REEF Transect CT-1 Oil? yes n= 10m² p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year Date	Organisms	Tegula funebralis (per)	Acanthina spirata (per)	Acm. scabra (per)	Acm. pelta	Mopalia mus (per)	Thais emarginata	A. elegantissima (per)	Pagurus samuelis	OTHER (per)
1969 4/4	X̄/unit	80.6	16.1							
	Σ	806	161	200		3				
	size	small-med 10/10	10/10	1/10		3/10				
Σ 1170	change									
1969 4/27	X̄/unit	119.8	8.4							
	Σ	1198	84	200		3				
	size	10/10	10/10	1/10		3/10				
Σ 1485	change									
1969 (8/1)	X̄/unit	67.3	10.6							
	Σ	673	100	200		2	2			
	size	10/10	9/10	1/10		2/10	1/10			
Σ 977 (~~983~~)	change									
1971 4/29 ++++ (14+)	X̄/unit	14.2	3.9							
	Σ	142	39	10	9	1				
	size	10/10	5/10	4/10	2/10	1/10				
Σ 201 (~~192~~)	change									
1971 7/23 N	X̄/unit									
	Σ	153, 3D	20	21spp	5	2		1	7	
	size	1.5cm - 3cm	2cm 7/10	1.5cm	2/10	10cm 25mm				
Σ 2094, 3D	change									
1971 8/10 N	X̄/unit									
	Σ	94L	17	50spp (11 scabra)	6	4	3	5	11	1 Teg. brunnea, 1 Pugettia, 1 Cancer, 1 Searlesia
	size	1-3cm	1½-2½cm	L-1.5cm		½", ¾", 2", 3"				
Σ 194	change									
	X̄/unit									
	size									
	change									
	X̄/unit									
	size									
	change									
	X̄/unit									
	size									
	change									
	X̄/unit									
	size									
	change									

DATA SUMMARY for Study Site DUXBURY REEF Transect C7-2 Oil? no n= 10 m² p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Tegula funebralis (per)	Mytilus californianus (per)	Anthopleura xanthogrammica + elegantissima (per)	Balanus glandula (per)	Littorina scutulata (per)	Pisaster ~~ochraceus~~	OTHER (per)
1969	4/3	X̄/unit	5.9	22.0	4.5				β acan spin dem *Poli; 2 Tegula brunnea
		Σ	59	220	45 XAN	800	1000	3 +2 cracked	
Σ 2131 + dem		size	4/10	1/10	7/10	1/10	1/10	1/10	1/10
~~Σ 2129~~ Bal x Pol		change							
1969	4/27	X̄/unit	7.9	22.0	4.8	80.0			β acan + acan *Poli; 5 Teg brunnea
		Σ	79	220	48 XAN	800	1000	3	
		size	4/10	1/10	7/10	1/10	1/10	1/10	1/10
Σ 2155 +		change							
1969	7/31	X̄/unit	6.8	24.1	5.6	80.0			β dem *Poli; 50 Acanthina
		Σ	68	241	56 XAN	800	1000	0	
		size	4/10	1/10	7/10	1/10	1/10		2/10
Σ 2215 +		change							
1971	7/23 N	X̄/unit				448 L 224 L; ~~357~~ 5.7 D			22 L, 1D Lacuna; 2 T dem scab; 120 Pollicipes
		Σ	157	520	29 XAN 3 ELE	113 D / 20 dm²	7	1	
		size	<1 cm	1/10	9=7-10 cm; 9=2-7.5 cm; 10=1-2.5 cm; 1-4 cm	10 dm² for 2 m²		4 cm	
Σ 1130, 1D + Bal/dm²		change							
		X̄/unit							
		size							
		change							
		X̄/unit							
		size							
		change							
		X̄/unit							
		size							
		change							
		X̄/unit							
		size							
		change							
		X̄/unit							
		size							
		change							
		X̄/unit							
		size							
		change							

DATA SUMMARY for Study Site DUXBURY REEF Transect C7-5 Oil? on ridge + n= 10m² p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Pisaster ogg. per	Anthopleura xanthogrammica per	OMIT Mytilus californianus per	add Acm. per	add Ale per	add crabs per
		X̄/unit						
		size						
		change		add A. ele				
		X̄/unit						
		size						
		change						
1969 Σ429	4/3	X̄/unit Σ	40	177	212			
		size	average 10"	some large	4"+ many			
		change						
1969 Σ427	4/21	X̄/unit Σ	38	177	212			
		size						
		change						
1969	7/31	X̄/unit Σ	51	182	220			
		size						
		change						
1970	12/9	X̄/unit Σ	33	(no count taken)				
		size						
		change						
1971 +	1/23	X̄/unit Σ	21					
		size						
		change						
1971 +	2/23	X̄/unit Σ	17					
		size						
		change						
1971 +	3/5	X̄/unit Σ	19					
		size						
		change						
~~1971~~	~~7/22-24~~	~~X̄/unit Σ~~	~~32~~	~~2529~~				
		size	~~15-25mm~~					
		change						

next page

DATA SUMMARY for Study Site DUXBURY REEF Transect CT-5 Oil? on ridge not on plots n= 14m² p. 2

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year Date	Organisms	Pisaster spp per	Anthopleura xanthogrammica AND A. ele. per	OMIT Mytilus californianus per	Acmaea / Littorina / Tegula per		Pollicipes / Balanus per		OTHER per
1971 1/22-1/24 SEASTAR CORNER =10m² Σ 2710 L, 1D	X̄/unit								16 Pagurus 5 Teg. spp 3 Cancer spp etc.
	Σ	32	★Σ 105 Axan ★Σ 2424 Aele	0	111	8L 1D	0	0	
	size	15-25mm							1 HEMI
	change								
not on computer: MUSSEL BEDS = 4 alternate m²	X̄/unit								Teg, Litt, Thais
	Σ	0	41 Axan	1822L 20D	yes		205L 1D	352L 27D	
	size			mostly 5cm 3-5-10 cm					
	change								
1971 8/8 SEASTAR CORNER =10m²	X̄/unit		no count						? Pagurus 5 Ceratostoma 2 Pugettia prod
	Σ	23	(same) 2529	0	120L 27D	7	0	0	
	size		105 = 5-15 cm rest = 1-5 cm						50-100mm
	change								
1971 10/6 -1.0 @ 7:45PM 16°C air 15°C water	X̄/unit								
	Σ	27 total only							
	size								
	change								
	X̄/unit								
	size								
	change								
	X̄/unit								
	size								
	change								
	X̄/unit								
	size								
	change								
	X̄/unit								
	size								
	change								
	X̄/unit								
	size								
	change								
	X̄/unit								
	size								
	change								

N? divide w/ than

CT-5
p2

TRANSECT WORKSHEET - G. Chan
January, 1971

Study Site Duxbury Reef
Area C Section 4 Channel ____
Transect CT-5 Type 10m² in seastar
Other corner and 4 alternate m² in mussel beds (10 dm² samples for check on Myt count)
Reference ____
Investigator ____

For the organism count of each species found, give total number alive and total number dead. If any shells have oil, give number with letter S in parentheses, e.g., (7S).

Year 1971 Date 7/22 Tide/Time -1.0 @ 6:36 AM Water temp. ____ Other ____
7/23 -0.8 @ 7:12 AM
7/24 -0.5 @ 7:42 AM

Size = cm
seastar corner

Organism Count Size=Avg. ~~mm.~~ cm (S=shells with oil)

Plot #	Oil?	Algae, other ~~Pagurus~~ OTHER	Pisaster spp Live	Dead	Size	A. xanthogrammica (①=5-15cm, rest=1-5cm) Live	Dead	Size	Acmaea spp. Live	Dead	Size	~~Other~~ Crabs Live	Dead	Size
1	oil on ledge on top of transect, but not in plots	scattered Balanus	3	0	15-25	669	0	7	54	0		0	none	
2		1 Lept	3	0	10-25	1522	0	{12 (②15.1/dm²)	13	0		~~2~~	~~Pagurus samuelis~~	
3		1 Lept	4	0	15-25	51	0	26	11	0		1	Hemigrapsus nudus	
4		0	2		20-25	45		10	29	0		2	Cancer ante	
5		1 Lept	1		20	19		7	4	0		0		
6		0	7		15-20	8		7	0			0		
7		2 Tonicella lineata, 1 Lept	1		20	115		7	0			{1, 1	Pagurus sam, Cancer productus (sm)	
8		1 D Lept	9		20-25	44		10	0			9	Pagurus	
9		2 Thais, 2 Teg. brunnea, 4 Lept	1		20-25	29		13	0			3	Pagurus	
10		3 Teg. funebralis	1	0	25	27	0	6	0			{1, 1	Pagurus, Pugettia producta	
Σ		8 L, 1 D Lept	32 (all ochraceus except 1 giganteus)	0		252~~4~~	0	①105	111	0		16, 1, 3, 1 = 21	Pagurus, Hemi, Cancer spp, Pugettia	

Year 1971 Date 7/24 Tide/Time -0.5 @ 7:42 AM Water temp. ____ Other ____

mussel beds
x̄/dm² also

Organism Count Size= Avg. ~~mm.~~ cm (S=shells with oil)

Plot #	Oil?	Algae, other	Myt. calif. Live	Dead	Size (ALL 15-100m; x̄/dm²)	Pollicipes poly Live	Dead	Size	Balanus glandula Live	Dead	Size (height)	A. xanthogrammica Live	Dead	Size
	no visible oil on mussel shells													
1	no	Teg, Litt, Acm, Thais	635	10	7.0	40	0		66	5	1-2	2		
3		Teg, Acm	478	6	4.9	25	0		19	1	1-2	0		
5		Teg, Litt, Acm, Thais, Chthamalus	288	0	3.1	133	1		198	16	1-3	0		
7		Teg, Litt, Thais, Chtham	421	4	5.2	7	0		69	5	1-3	39		
Σ			1822	20	20.2 (x̄ 20.20)	205	1		352	27		41	0	

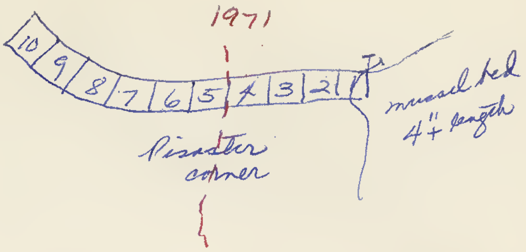
TRANSECT WORKSHEET - G. Chan
January, 1971

Study Site DUXBURY REEF

Area C Section 4 Channel ____

Transect CT-5 Type 10 m² in seastar corner

Other and 4 alternate m² in mussel beds
(10 dm² [illegible])



Reference ____

Investigator ____

For the organism count of each species found, give total number alive and total number dead. If any shells have oil, give number with letter S in parentheses, e.g., (7S).

Year ____ Tide/Time ____ Water temp. ____ Other ____

Organism Count Size=Avg. mm. (S=shells with oil)

Plot #	Oil?	Algae, other	Pisaster ochraceus Live	Dead	Size	A. xanthogrammica Live	Dead	Size	Mytilus cal. Live	Dead	Size	Live	Dead	Size
1 through 10		1971 Σ												
		1/23	21											
	yes	2/23	17			no counts taken								
	on top of transect ridge	3/5	19											

Year 1971 Date ____ Tide/Time ____ Water temp. ____ Other ____

Organism Count Size= Avg. mm. (S=shells with oil)

Plot #	Oil?	Algae, other	P. ochraceus Live	Dead	Size	A. xanthogrammica Live	Dead	Size	Mytilus cal. Live	Dead	Size	Live	Dead	Size
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														

see next page

also mussel beds, plots of m²
#1, 3, 5, 7 — check Larry Andrews pre-data

C-T5

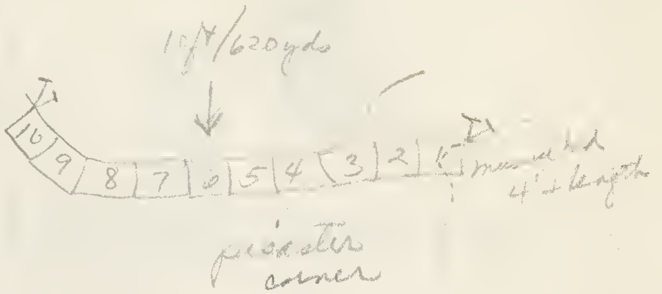
TRANSECT WORKSHEET - G. Chan

Location - Site Title DUXBURY

Starfish Corner

Area C Section ____ Transect T5

Other Range side to white grey gable roof (10 ft) house with cypress in background 10 ft/620 yds



Reference

Chan's Ph. D. notes

mussels (1969) in plot #1 = 4"+ length
Pisaster (1969) in # 4 = 10" avg arm span
Anemones (1969) in #6 = LARGE

Year	Date	Tide	Other conditions	Plot, Strip	Description
1969	6/3		1 transect, 10 square meter plot	#1	212 myt; Pisaster ochraceous
				#2	— 20 Antho
			#1-mussels 4+ length	#3	— 43 A x,
				#4	— — 8 Pisa, many empty mussel shells
			#2-large anemones	#5	— — 8 Pisa
				#6	— 30 Ax —
			#4 - large Pisaster avg 10" arm span	#7	— 6 Ax, 8 Pisa
				#8	— 27 Ax 15 Pisa
			#6 large anemones	#9	— 37 Ax, 1 Pisa
				#10	— 14 Ax, —
					212 myt, 177 Ax, 40 Pisaster
1969	6/27			#1	212 myt
				#2	— 20 Ax
				#3	— 43 Ax
				#4	— — 6 Pisa
				#5	— — 6 Pisa
				#6	— 30 Ax —
				#7	— 6 Ax 10 Pisa
				#8	— 27 Ax 14 Pisa
				#9	— 37 Ax 1 Pisa
				#10	— 14 Ax 1 Pisa
			Total		212 myt 177 Ax, 38 Pisaster
1970	12/9		No. of starfish 10 meters	1-10	38 pisaster
1971	Feb 23		" "	1-10	17 Pisaster

next page

Transect Worksheet

C-T5

Year	Date	Tide	Other conditions	Plot, Strip	Description
1969	7/31			#1	220 myt
				#2	– 23 Ax
				#3	– 42 Ax 10 Pisa
				#4	– – 10 Pisa
				#5	– – 10 Pisa
				#6	– 30 Ax 4 Pisa
				#7	– 7 Ax 6 Pisa
				#8	– 29 Ax 11 Pisa
				#9	– 37 Ax –
				#10	– 14 Ax –
			Total		220 myt 182 Ax 51 Pisaster
1970	12/9	-0.7	Bio 1A Class	1-10 meters	33 Pisasters in 10 meters
1971	2/23		Bio 1A Class	1-10 meters	17 Pisasters in 10 meters
1971	Mar 5			1-10 meters	19 Pisasters
1971	Jan 23		with Chromide man Someid	1-10 meters	21 Pisasters

3-5 no need for computer data sheet

DATA SUMMARY for Study Site DUXBURY REEF Transect CT-6 Oil? + n= 1 m² p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Acmaea scabra per	Tegula funebralis per ★	Hopkinsia rosacea per	per	per	per
1968 -0.9	6/26	$\bar{X}$/unit Σ size change	39 removed m² scraped	0	0			
1969 -0.9	6/28 rock covered with Fucus furcatus	$\bar{X}$/unit Σ size change	4	0	0			
1970 -0.5	3/31	$\bar{X}$/unit Σ size change	6	0	0			
1971 +oil 10 NW mph, clear	3/6 fucus & ulva covers 25% of m²	$\bar{X}$/unit Σ size change	36 (15)	2 ★	1			
1971 +	4/25 algae, mostly ulva, covers 70%	$\bar{X}$/unit Σ size change	27 (15)	≥25 ★ all under algae	1			
1971 + -0.8	5/15 algae covers 75%	$\bar{X}$/unit Σ size change	26 (15)	≥30 ★ under ulva	1			
1971 + 0.0	5/30 large limpet(s) is gone	$\bar{X}$/unit Σ size change	26	★ ≥40 under & over ulva	1			
1971 + -1.3	6/10 algae covers ≥75%	$\bar{X}$/unit Σ size change	21	≥40 ★	0			
1971 no oil -0.8	7/23	$\bar{X}$/unit Σ size change	6 more outside m² plus Aela	0	0	OMIT Pagurus samuelis 10		
1971 no oil	8/10	$\bar{X}$/unit Σ size change	3	21 ★	0	0		

3-5 no need for computer sheet + single

DATA SUMMARY for Study Site DUXBURY REEF Transect CT-6 Oil? not since 7/23/71 n= m² p. 2

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Acmaea scabra per	Tegula funebralis per	per	per	per	per
1971		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
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		X̄/unit						
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		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						

Post-Oil Spill Studies --- Duxbury Reef Spring 1971

Four areas on section C of the reef were studied. Three of these were transects.

CT-6 1) Limpet Square - In June 1968 a square meter was scraped clean of the limpet Acmea Scabra. The purpose was to measure rate of replacement. In March of 1970 there were 6 replacements. In March of 1971, when my study started, there were 36 Acmea. ~~Bu~~ As the figures show, the number decreases as summer approaches, and the Ulva and Fucus spread over the square. Acmea does not seem to tolerate living under a great carpet of algae such as Ulva. The limpets were only found in areas of bare rock, the ones that were settled where the Ulva now grew had moved out.

CT-7 2) Mushroom Rock - During the winter the upper part of this rock is populated only by barnacles. During the summer different gastropods move in and climb the rock. Splotches of oil can bee seen dried and hardened on parts of the sides and top of the rock. In places where barnacles were living and then covered with oil, it can be seen that about half the shells are empty, probably due to the smothering oil.

My study of this rock was a population and distribution study mainly with Tegula funebralis and Acanthina spirata. During the migration upward, the carnivoirous Acanthina was always above the herbivoirous Tegula, which seems unusual if Tegula is to be the prey. I never did see an Acanthina eating a Tegula. The study included everything ~~on~~ inside the m^2, including the base of the rock within the square.

CT-9
3) Sea Urchin Transect - In July 1968 there were 7 Urchins counted on the transect. This spring I did not find one. I did find one very near the transect, as shown on the map, but between 5/15 and 5/30 it disappeared. Possibly it migrated, for I don't think it was killed. It was in a deep burrow under an overhang, very difficult to reach or see.

CT-8
4) Tidepool Study - I intended to do a thorough job on Tony's pool by keying out as many animals and plants as possible, constructing a food chain, and making observations. Several times the water was too cloudy to see anything, and other times I was busy with other transects. At any rate I got a few chances to look closely and make some observations.

This pool is not particularly suited for an ideal food chain because new factors are dumped in with each tide. Sometimes there are sculpins present while other times they are not. Depending upon the time of year there may be lots of algae or a decreased amount. Certain animals, such as the crap *Pachygrapsus crassipes* can be found around the edges of the pool, but inside only occasionally. Therefore it cannot be considered along with animals confined to the pool.

Included with this section are observations made on *Anthopleura xanthogrammica* from my term paper.

CONCLUSIONS: From my data I see little evidence of damage to organisms in this study from oil. Barnacles were killed when covered with oil, and this is the only visible evidence. I had not seen the reef before the spill, so my conclusions are not completely valid.

3-6

DATA SUMMARY for Study Site DUXBURY REEF Transect CT-7 Oil? + n= single m^2 p. 2

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Tegula funebralis per	Acanthina spirata per	★ Balanus glandula per	★ Littorina scutulata per	★ Acmaea ~~testudinalis~~ spp per	A. elegantissima per	Pagurus samuelis
1971	7/23	X̄/unit	4 on top under gigartina; 16 above neck	12 below; 27 neck; 95 above	140L, 1650D (60S) (150S)	210L	2 scab; 150 digi; 2 pelta	4	0
+		size	251 25mm	<8mm	1-3mm	2mm			
-0.8		change Σ	271	134					
1971	8/10	X̄/unit Σ	256 neck + below; 4 above neck; 7 on top	11 neck + below; 1 above	(same)	150L	8 scab 15cm; 145 digi; 2 pelta	11	11
+		size	1-3 cm	18mm	omit here [illegible]	many <2mm			
0.5		change	267 plus 1 commensal [illegible]	12					
		X̄/unit							
		size							
		change							
		X̄/unit							
		size							
		change							
		X̄/unit							
		size							
		change							
		X̄/unit							
		size							
		change							
		X̄/unit							
		size							
		change							
		X̄/unit							
		size							
		change							
		X̄/unit							
		size							
		change							
		X̄/unit							
		size							
		change							

DATA SUMMARY for Study Site DUXBURY REEF Transect CT-7 Oil? +✓ n= 1m² p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Tegula funebralis per	Acanthina spirata per	Balanus glandula ★ per	Littorina scutulata ★ per	Acmaea scabra ★ per	A. elegantissima Pagurus per
		$\bar{X}$/unit, size, change						0
1969 −0.7	6/17	$\bar{X}$/unit, Σ, size, change	348	258	(thousands	——)	yes	
1969	6/27	$\bar{X}$/unit, Σ, size, change	268	37	"	"	yes	
1969	7/30	$\bar{X}$/unit, Σ, size, change	304	272	"	"	yes	
1971 more +? −0.4	4/1 numerous splotches top + sides	$\bar{X}$/unit, Σ, size, change	28 below neck 2 above neck	5 below 0 above	thousands — 50% of shells empty where oil splotches exist 50% D	very few (mostly at base	very few & higher crevices)	
1971 +	4/25	$\bar{X}$/unit, Σ, size, change	16 below 0 above	7 below 0 above	Bal L + D ★ ★	≥100 limpets mostly on surface		
1971 + −0.8	5/15	$\bar{X}$/unit, Σ, size, change	109 below	105 ↑ 23 below 82 above				
1971 +	5/30	$\bar{X}$/unit, Σ, size, change	274 below	111 (many S) ↑ 76 below 35 above; change: quite a few (S) but below neck				
1971 + −1.3	6/10	$\bar{X}$/unit, Σ, size, change	50 below 170 neck	105 11 below 5 neck 89 above	↓	✓	≥50	0
see page 2		$\bar{X}$/unit, size, change						

see page 2

omit 3-7

DATA SUMMARY for Study Site DUXBURY REEF Transect CT-10 Oil? ++ n=_____ p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Lottia per	per	per	per	per	per
~~1962~~ 1959	~~4/18~~ 2/11	X̄/unit						
		Σ	28					
-1.5		size						
		change						
1962	5/30	X̄/unit						
		Σ	23					
		size						
		change	-5					
1965	6/29	X̄/unit						
		Σ	21					
		size						
		change	-2					
1968	6/27	X̄/unit						
		Σ	16					
-0.9		size						
		change						
1970	12/9	X̄/unit						
		Σ	21					
-0.7		size						
		change						
1971 (circled)	2/23	X̄/unit						
		Σ	22					
++		size						
		change						
1971	3/5	X̄/unit						
		Σ	19					
++ -0.2		size						
		change						
1971	7/23	X̄/unit						
		Σ	11					
++		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						

attenuata

DATA SUMMARY for Study Site DUXBURY REEF Transect CT-9 Oil? ____ n= 5m² p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Strongylocentrotus purpuratus per	per	per	per	per	per
1968	7/16	X̄/unit						
		Σ	7					
		size						
		change						
1971	3/20	X̄/unit						
		Σ	0					
		size						
		change						
1971	4/25	X̄/unit						
	5/15	Σ	0					
	5/30	size						
	6/10	change	only one urchin found near transect, outside #5; it disappeared bet 5/15 & 5/30 ✓					
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						

DATA posted

1972 posted ✓ [illegible]

DATA SUMMARY for Study Site DUXBURY REEF Transect CT-11 Oil? + n=[illegible] p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Anthopleura xanthogrammica per	per	per	per	per	per
1968	6/27	X̄/unit	Σ 56					
-0.9		size						
		change						
1971	2/23	X̄/unit	Σ 56					
+		size						
		change						
1971	3/23	X̄/unit	Σ 55	A fan w/ shells: 20°C A fan w/o shells: 23.5°C				
+ -0.6		size						
		change		Internal				
1971	7/23	X̄/unit	Σ 54	submerged temp = 13.5 not submerged = 13.0				
N		size						
		change		size of A fan				
1971 N	8/10	X̄/unit	Σ 54	submerged	↓ internal 8cm 16.0°C 11cm 16.0°C 18c 19.5°C 5cm 16.8°C	surrounding 16.0°C 16.0°C 18.0°C 15.8°C air temp at mouth of A fan	Submerged 7cm 16.0°C 11cm 16.0°C 15cm 15.0°C 4cm 15.0°C Internal	tidepool temp 14.0°C 14.8°C 14.0°C 14.0°C
ocean = 12.2°C air = 14.2°C		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						

omit 3-9

DATA SUMMARY for Study Site DUKBURY REEF Transect CT-12 Oil? N n= single m² sieve p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Saccoglossus per	per	per	per	per	per
1962	1/18	X̄/unit						
		Σ	106					
		size						
		change						
1965	4/29	X̄/unit						
		Σ	38					
		size						
		change						
1968	4/25	X̄/unit		1mm nylon mesh				
		Σ	88 heads w collars					
		size						
−0.8 @ 6:44 AM		change	~~1mm nylon mesh~~					
1971	3/25	X̄/unit						
		Σ	9					
		size						
		change						
1971	7/10	X̄/unit		10 cm deep				
		Σ	20					
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						

3-10
4/11

DATA SUMMARY for Study Site DUXBURY REEF Transect CT-15 Oil? ____ n= m² every 25 m every 50 m p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Strongylocentrotus purpuratus per m²	Platyodon cancellatus per m²	per	per	per	per
1971	7/23 + 7/24	$\overline{X}$/unit	15.2	7.3L 2.3D				
	-0.8 -0.5	Σ	152	73L, 23D				
n=20	7/25 + 7/27	size	n=10N	n=10+				
	0.0 1.0	change		7N, 3+				
		$\overline{X}$/unit						
		size						
		change						
		$\overline{X}$/unit						
		size						
		change						
		$\overline{X}$/unit						
		size						
		change						
		$\overline{X}$/unit						
		size						
		change						
		$\overline{X}$/unit						
		size						
		change						
		$\overline{X}$/unit						
		size						
		change						
		$\overline{X}$/unit						
		size						
		change						
		$\overline{X}$/unit						
		size						
		change						
		$\overline{X}$/unit						
		size						
		change						

3-10 CT-15
+3-11 oil

oil 0 — oil 2

7/23, 24, 25, 27/71 — n = 20 m²

3-10 Strongy		Platyo 3-11	
Zone 4 N 1	26	Zone 2 A	22L, 4D
2	0		0L, 0D
3	20		2L, 0D
4	0		26L, 5D
5	39		4L, 1D
6	65		1L, 0D
7	2	N	9L, 7D
8	0	+	0L, 0D
9	0	+	5L, 4D
N 10	0	+	4L, 2D
Σ	152		73L, 23D

3-12
N

Tagged Abalones

	Island	Shark Rock	Bolinas Pt
	CT-13	CT-14	CT-15
	m^2 1	m^2 2	m^2 3
4/23/67	5 A	2 A	
4/26/68	5 A	2 A +1	3 A
4/23/69			2 A
N 4/30/71	1 A (5 dives / 20 dives)		
N 7/8/71		2 A +1	

COMBINE + 14 + Bolinas (3-12)

DATA SUMMARY for Study Site DUXBURY REEF Transect CT-13 Oil? no n= [illegible] p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Haliotis rufescens			Hermissenda crassicornis		3-12(0) m² = site dm² = direction transect
			per	per	per	per	per	per
1967	4/23	X̄/unit						
		Σ	5 tagged			(no count ~~taken~~)		
−0.9		size	8⅛", 8⅞", 9⅛", 9⅜", 9½"					
		change	8					
1968	4/26	X̄/unit						
		Σ	5 (same ones)			(no count)		
−0.9		size						
		change						
1971 No oil	4/30	X̄/unit						
		Σ	1 (8⅛" tagged)	} 5 divers, each making ~~[illegible]~~ 4 dives		Σ 8	abundant hydroids, tunicates, no crabs	~~[illegible]~~ abundant kelp
−0.5		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						

3-12

DATA SUMMARY for Study Site Duxbury Reef Transect ~~CT-14~~ 13 Bolinas Pt Oil? N n= Shark Rock p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Haliotis rufescens per	per	per	per	per	per
1967	4/23	$\bar{X}$/unit						
		Σ	2 tagged					
		size	8 3/4", 9"					
-0.9		change						
1968	4/24	$\bar{X}$/unit						
		Σ	3 (2 tagged)					
		size	7 7/8"					
-0.9		change						
1971	7/8	$\bar{X}$/unit						
		Σ	3 (same as above)					
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						

DATA SUMMARY for Study Site DUXBURY-BOWNE POINT Transect BP-1 Oil? N n= ___ p. ___

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date		Organisms: Haliotis rufescens per	per	per	per	per	per
1968	6/26	X̄/unit Σ	3 tagged					
		size	9", 7 1/8", 7 3/4"					
-0.9		change						
1969	6/23	X̄/unit Σ	2 tagged					
		size	9" missing					
-1.1		change						
~~1971~~	~~7/21~~	X̄/unit ~~Σ~~	~~8~~					
		size						
~~+1.0~~		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						

DATA SUMMARY for Study Site FORT BAKER Transect FB-1 Oil? no n= 50 dm² p. 1

5 in each 10 m²

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date		Organisms: Balanus glandula	Chthamalus dalli	Σ			
			per dm²	per dm²	per	per	per	per
1971	7/23	X̄/unit	56.8	34.0	90.7			
		Σ	2838 L	1698 L	4536			
	50 dm²	size						
NEW TRANSECT		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						

50 dm², 5 in each of 10 m²

5-1 FB-1
no od

Other species present YES

7/23/71 all live

	B. pendula	C. dadii	= Σ
1-1	65	52	= 117
1-2	18	37	= 55
1-3	206	113	= 319
1-4	0	0	= 0
1-5	79	46	= 125
Σ1-0	368	248	= 616
2-1 [6]	5	9	= 14
2-2 [7]	67	56	= 123
2-3 [8]	295	32	= 327
2-4 [9]	41	68	= 101
2-5 [10]	110	57	= 167
Σ2-0	518	214	= 732
3-1 [11]	55	150	= 205
3-2 [12]	1	14	= 15
3-3 [13]	33	26	= 59
3-4 [14]	163	98	= 261
3-5 [15]	73	52	= 125
Σ3-0	325	340	= 665
4-1 [16]	0	0	= 0
4-2 [17]	28	31	= 59
4-3 [18]	3	13	= 16
4-4 [19]	143	108	= 251
4-5 [20]	4	0	= 4
Σ4-0	178	152	= 330
5-1 [21]	43	42	= 85
5-2 [22]	84	31	= 115
5-3 [23]	5	4	= 9
5-4 [24]	0	0	= 0
5-5 [25]	6	55	= 61
Σ5-0	138	132	= 270

	B.	C.	total
6-1 [26]	14	17	= 31
6-2 [27]	213	72	= 285
6-3 [28]	0	0	= 0
6-4 [29]	0	0	= 0
6-5 [30]	36	25	= 61
Σ6-0	263	114	= 377
7-1 [31]	205	53	= 258
7-2 [32]	32	0	= 32
7-3 [33]	174	57	= 231
7-4 [34]	8	23	= 31
7-5 [35]	0	0	= 0
Σ7-0	419	133	= 552
8-1 [36]	0	0	= 0
8-2 [37]	38	20	= 58
8-3 [38]	0	0	= 0
8-4 [39]	81	38	= 119
8-5 [40]	15	0	= 15
Σ8-0	134	58	= 192
9-1 [41]	9	29	= 38
9-2 [42]	7	9	= 16
9-3 [43]	94	152	= 246
9-4 [44]	0	0	= 0
9-5 [45]	40	8	= 48
Σ9-0	150	198	= 348
10-1 [46]	16	3	= 19
10-2 [47]	6	53	= 59
10-3 [48]	186	0	= 186
10-4 [49]	137	53	= 190
10-5 [50]	0	0	= 0
Σ10-0	345	109	= 454

oil graded off before 1st post count

DATA SUMMARY for Study Site STINSON BEACH Transect SB-1 Oil? yes n= 9m² p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Emerita analoga per m²	Orchestoidea californiana per m²	Nephtys californiensis per m²	Siliqua patula / Olivella biplicata per m²	Archaeomysis maculata / Blepharipoda occidentalis per m²	Excirolana kincaidi per
1965	7/15	Σ X̄/unit	71 7.9 5.3♀ 2.6♂	24 2.7	47 5.2	3 2 0.3 0.2	46 1 5.1 0.1	
	n=9m²	size	6/9	2/9	1/9	1/9	1/9	
		change						
1970	2/17	Σ X̄/unit	68 7.6 4.4♀ 3.2♂	6 0.7	28 3.1			
	n=9m²	size	5/9	2/9	1/9	0 0	0 0	
		change	-0.3	-2.0	-2.1			
1971 (circled)	4/16	Σ X̄/unit	10 [illegible] 1.1 [illegible] no ♀♀				1 0.1	
	n=9m²	size	20-25mm 4/9	0	0	0 0	1/9 0	
		change	-6.5	-0.7 [overwritten]				
1971	7/23 n=10m²	X̄/unit Σ	1.6♀ 16♀ no ♂	0				1
		size	20-35mm 4/10					
		change	+0.5					
1971	7/23 n = additional 4m²	X̄/unit	2.3♀ 9♀ no ♂	0	1.0 4	1	1	#
		size	4/4		50-85mm 3/4	15mm	~~80mm~~ 80mm	23mm
		change	1.8 14 25 10 X̄=1.8		0.3 14 14 X̄ = 0.3			
1972	3/10 n = 9m²	X̄/unit Σ	1.1 10	0.9 8	0	0 0	0 0	0
		size	2/8	1/8				
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						

combine (the two 1971 7/23 rows)

DATA SUMMARY for Study Site CHIMNEY ROCK Transect CR-1 Oil? N n= 10m² (alternate) p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

CR-1

Year	Date	Organisms	Balanus (per)	Tegula funebralis	Pachy, hemi (per)	Cancer, Lophopanopeus	Pisaster (per)	Leptasterias	Strongylo (per)	Anthopleura	HALIOTIS (per)	Littorina planaxis	Acmaea spp. (per)	Thais emarginata	Other
1970	7/7	$\bar{X}$/unit													3 Mopalia 3 Oabella 2 Cryptochiton 4 Idothea 15 Pycno 5 Petro 3 Epiactis
		Σ	3,448	111	164	32	3	6	7	40	2	2,590	142	75	
		size													
n=10m² alternate		change													
1971	8/5	$\bar{X}$/unit													
incomplete count		size													
		change													
		$\bar{X}$/unit													
		size													
		change													
		$\bar{X}$/unit													
		size													
		change													
		$\bar{X}$/unit													
		size													
		change													
		$\bar{X}$/unit													
		size													
		change													
		$\bar{X}$/unit													
		size													
		change													
		$\bar{X}$/unit													
		size													
		change													
		$\bar{X}$/unit													
		size													
		change													
		$\bar{X}$/unit													
		size													
		change													

DATA SUMMARY for Study Site CHIMNEY ROCK Transect CR-2 Oil? N n= alternate 10 m² p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Cancer, Pagurus, Pugettia (per)	Tegula	Pisaster (per)	Leptasterias	Pycnochilian (per)	Strongylo	Anthopleura CR-2 (per)	Pycnosterias	Epiactis (per)	Cryptochiton	HALIOTIS (per)	
1970	7/7	$\bar{X}$/unit Σ	22	3 brunnea	3	33	5	45	6 fan	2	27	3	8	3 Patiria 3 dam mitra
n=10 alternate m²		size												
		change												
1971	8/5	$\bar{X}$/unit												
incomplete		size												
		change												
		$\bar{X}$/unit												
		size												
		change												
		$\bar{X}$/unit												
		size												
		change												
		$\bar{X}$/unit												
		size												
		change												
		$\bar{X}$/unit												
		size												
		change												
		$\bar{X}$/unit												
		size												
		change												
		$\bar{X}$/unit												
		size												
		change												
		$\bar{X}$/unit												
		size												
		change												
		$\bar{X}$/unit												
		size												
		change												

DATA SUMMARY for Study Site CHIMNEY ROCK Transect CR-3 (CR-3) Oil? N n= alternate 10 m² p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Balanus per	Tegula	Littor. scut per	Pagurus	Pisaster per	Leptasterias	Anthopleura per	Acmaea	Crepidula adunca per	Thais	Acmaea spp per	Chthamalus
1970	7/1	X̄/unit Σ	40	67 fun	30	9	2	5	14 ele 1 fun		10	4	211	70
		size												
10 alternate m²		change												
1971	8/5	X̄/unit												
incomplete count		size												
		change												
		X̄/unit												
		size												
		change												
		X̄/unit												
		size												
		change												
		X̄/unit												
		size												
		change												
		X̄/unit												
		size												
		change												
		X̄/unit												
		size												
		change												
		X̄/unit												
		size												
		change												
		X̄/unit												
		size												
		change												
		X̄/unit												
		size												
		change												

1 Hemi[illegible]
3 Epiac[illegible]
2 Crypt[illegible]
4 Pateri[illegible]
2 Mopli[illegible]
1 Obelia

DATA SUMMARY for Study Site CHIMNEY ROCK Transect CR-4 Oil? N n= alternate 3m² p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	per	per	per	per	per	per
1970	7/7	X̄/unit						
		size change						
1971	8/5	X̄/unit						
		size change						
		X̄/unit						
		size change						
		X̄/unit						
		size change						
		X̄/unit						
		size change						
		X̄/unit						
		size change						
		X̄/unit						
		size change						
		X̄/unit						
		size change						
		X̄/unit						
		size change						
		X̄/unit						
		size change						

10 m² each direction N, W, S, E at each of 3 rocks 8-1 intertidal
CR-ST-

DATA SUMMARY for Study Site CHIMNEY ROCK Transect 5,6,7 Oil? N n= p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Haliotis rufescens per	Strongylocentrotus purpuratus per	per	per	per	per
1970	7/7	X̄/unit	1.6	0.9				
		Σ	88	52				
60 m²		size	37/60	10/60				
		change						
1971	10/17	X̄/unit	1.4	0				
		Σ	136	0				
100 m²		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						

DATA SUMMARY for Study Site BIRD ROCK Transect 9-1 (BR-1) Oil? N n= ____ p. ____

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Mytilus (per)	Pollicipes	Balanus (per)	Tegula funebralis	Littorina (OMIT) (per)	Acmaea	Pagurus / Pugettia (per)	Anthopleura	Strongylocentrotus (per)	Idothea ×	Petrolisthes × (per)	
1970	6/24	X̄/unit Σ	710	380	100	119	50 plan 5 scut	237 scab	23 Pag 4 Pug	692 fun 50 ele	98	55	1400	1 Thais 58 pi 1 Pisaster
10 alternate m^2		size												
		change												
1971	8/6	X̄/unit Σ								409 ele 8 fun				337 Thais
8 alternate m^2		size												
		change												
		X̄/unit												
		size												
		change												
		X̄/unit												
		size												
		change												
		X̄/unit												
		size												
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		size												
		change												
		X̄/unit												
		size												
		change												
		X̄/unit												
		size												
		change												
		X̄/unit												
		size												
		change												

Bird Rock int 9-1

alternate m²
oil? N

4/24/70

	Leg	Acm	Litt	Myt	Poli	Bal	Apen	Ael	Strong	CPP
1	10	50	0	10	0	0	0	0	0	0
2	0	95	5	200	80	100	0	0	0	0
3	26	42	0	0	0	0	☆300	0	0	0
4	0	0	0	0	0	0	60	0	0	10
5	0	0	0	0	0	0	0	0	0	13
6	0	50	0	0	0	0	0	0	0	0
7	10	0	0	0	0	0	25	0	0	0
8	3	6	0	0	0	0	☆100	0	0	0
9	0	0	0	100	0	0	7	50	98	0
10	70	0	0	400	300	0	☆200	0	0	0

4/24/70 9-3

alternate m²

	Leg	Acm	Litt (omit for COMPUTER PLAN)	Myt	Pol	Bal	Pis	Aen	Strong	PAC	CPP
1 –	0	0	~~200~~ 0	0	0	0	0	0	0	1	0
2 –	0	0	~~8~~20	0	0	20	0	0	0	1	0
3 –	0	0	~~0~~ 8	0	0	50	0	0	0	0	0
4 –	21	0	0	0	0	50	0	0	0	0	0
5 –	140	0	0	13	0	0	0	32	0	1	90
6 –	70	13	60	14	0	0	0	0	0	2	0
7 –	150	0	6	5	0	50	2	0	0	2	0
8 –	64	0	0	60	7	0	0	6	11	0	8
9 –	0	23	0	48	8	60	2	0	0	3	0
10 –	0	5	0	0	0	50	2	5	0	0	0

(over)

9-4 subtidal oil?
BR-4

6/24/70

		Hal	Strong
m^2 1 — dm^2 1	(N)	12	3
2	(W)	16	100
3	(S)	4	173
4	(E)	13	42

(3/6/14 del 1972)

8/4/71

m^2 1 — dm^2	Hal	Strong
1	2	☆
2	3	no ☆
3	0	count ☆
4	1	☆

5/14/71

m^2 1 — dm^2		
1	3	5
2	5	38
3	0	260 } 100 purple, 160 red
4	2	25 red

E-10-1 subtidal
DP-1 +2

pre-oil?
(separate N, W, S, E counts)

7/27/71

		Hal	S
m^2 1	N dm^2 1	3	☆
	W 2	1	
	S 3	2	
	E 4	2	
m^2 2	N 5	1	
	W 6	3	
	S 7	0	
	E 8	0	☆

~~6/23/70~~

~~m^2 1 — dm^2~~	Hal	Strong
1 (N)	2	
2 (W)	2	
3 (S)	1	
4 (E)	3	

m^2 1

		Hal	S
m^2 1	N dm^2 1	4	☆
	W 2	0	
	S 3	0	
	E 4	2	
m^2 2	N 5	2	
	W 6	2	
	S 7	1	
	E 8	3	☆

TRANSECT WORKSHEET - G. Chan
January, 1971

BR-1
p1

Study Site: Bird Rock

Area ____ Section ____ Channel ____

Transect: BR-1 Type: 15 alternate

Other: m² (odd numbered)

N

pre-oil data

Reference ____

Investigator ____

For the organism count of each species found, give total number alive and total number dead. If any shells have oil, give number with letter S in parentheses, e.g., (7S).

Year 1970 Date 4/24 Tide/Time -0.5 Water temp. ____ Other ____

Organism Count Size=Avg. mm. (S=shells with oil)

Plot #	Oil?	Algae, other	Mytilus Bil Live	Dead	Size	Teg Thais Litt Live	Dead	Size	Acm Live	Dead	Pag Size	Antho Live	Dead	Strong Size
1			10	Poly 0	0	10 juv	0	0	50 scab		0	0	0	
3			200	80	100	0	1	{10 dam 5 scut}	95 scab		0	0	0	
5		Idothea	0	0	0	26 f	0	40 dam	42 scab		0	300 ...	5 Epi	
7			0	0	0	0	0		0		10 h	60 ...	0	
9			0	0	0	0	0	0	0		{5 a 8 h}	0	0	0
11		none				10 f			50 scut			25 ...		
13			0			8 f						100 ...		
15		15 Idothea, 1 Patiria	0									{7 ... 50 ele}		
17		14 Idothea, 2 Pugettia	100							400 Petro		200 ...		98
19		25 Idothea 2 Pugettia; 25 Cucumaria, 2 Dermasterias	400	300		70 f								
		55 Idothea 4 Pugettia 1 Patiria	710	380	100	119	1	50 dam 5 scut	237 scab	1400 Petro	23 ...	692 ... 50 ele	5 Epi	98S

Year ____ Date ____ Tide/Time ____ Water temp. ____ Other ____

Organism Count Size= Avg. mm. (S=shells with oil)

Plot #	Oil?	Algae, other	Live	Dead	Size	Live	Dead	Size	Live	Dead	Size	Live	Dead	Size
21		1 Idothea, 1 colony Plocamium karykina, 1 colony Leucosolenia								1 Petro				
23		1 Dermasterias, 1 Diodora, 1 Tonic, 2 Patiria									1 Hem	34 ...		
25		1 colony Clavelina huntsmani												
27		none												
29		1 colony Clavelina												

TRANSECT WORKSHEET - G. Chan
January, 1971

BR-1
p2

Study Site BIRD ROCK

Area____ Section____ Channel____

Transect BR-1 Type 15 alternate

Other N

Reference____

Investigator____

For the organism count of each species found, give total number alive and total number dead. If any shells have oil, give number with letter S in parentheses, e.g., (7S).

Year 1971 Date 8/6 Tide/Time____ Water temp.____ Other____

OMIT

Plot #	Oil?	Algae, other	Myt Poly Bal Live	Dead	Size	Teg. thais Litt Live	Dead	Size	Anem Live	Dead	Size	Antho Live	Dead	Size
1		[illegible]	7	0	4304	11 f	0	68 sp	228			[illegible]		
3			542	200	101	0	10 den	{45 plen 5 bent	35					
5		1 Isothea, 1 Pis				43 f		40 plen	44			198 ele 5 Epi		
7		NO COUNT												
9		NO COUNT												
11		NO COUNT (none before)							34			{5 plen 8 ele		
13		Rotunga Lept	1			10 f								
15					100	25 f			30			20 ele		
17			13/dm²		2000	9 f	2 ent		152			{3 plen 17 lele		
19			1248	1 dung	75/dm²	1/dm²	21		10/dm²			42 ele		
			N 3098		N 14905	N 198	33	85 plen 5 ent	N 1523			409 Acle 8 Arten 5 Epi		

Year____ Date____ Tide/Time____ Water temp.____ Other____

Plot #	Oil?	Algae, other	Live	Dead	Size	Live	Dead	Size	Live	Dead	Size	Live	Dead	Size
21		Moni,							11	2 Pagurus		9 ele	1 Pisaster	
23		no count tide in												
25														
27														
29														

Organism Count Size=Avg. mm. (S=shells with oil)

TRANSECT WORKSHEET - G. Chan
January, 1971

BR-2
p1

Study Site BIRD ROCK

Area ____ Section ____ Channel ____

Transect BR-2 Type alternate

Other m² (odd numbered)

Reference ____

Investigator ____

For the organism count of each species found, give total number alive and total number dead. If any shells have oil, give number with letter S in parentheses, e.g., (7S).

Year 1970 Date 6/24 Tide/Time -0.5 Water temp. ____ Other ____

Organism Count Size=Avg. mm. (S=shells with oil)

Plot #	Oil?	Algae, other	Acm Live	Acm Dead	Acm Size	Litt / Lig Live	Dead	Size	Live	Dead	Size	Live	Dead	Size
1			15 scab											
3			10 scab			16 of								
5		1 mog ligu	7 scab, 10 digi		5 pen				1 Cancer					
7		NONE							1 Pag					
9		3 Ithothea												

Year 1971 Date 8/6 Tide/Time ____ Water temp. ____ Other ____

Organism Count Size= Avg. mm. (S=shells with oil)

Plot #	Oil?	Algae, other	Acm Live	Acm Dead	Acm Size	Litt / Lig Live	Dead	Size	Live	Dead	Size	Antho Live	Dead	Size
1		1 Pycno st	51						1 Pag			8 ele		
3		no count												
5														
7												8 ele, 11 ele		
9		10 mog, 1 Pis	58											

DATA SUMMARY for Study Site BIRD ROCK Transect 9-3 Oil? N n= ____ p. 1

BR-3

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	Pachy; Hemi per	Pag; Pag; Cenc	Pisaster per	Mytilus	Balanus per	Pollicipes	Tegula per	Littorina (OMIT)	Anthopleura per	Acmaea	Strongy per	
1970	6/24	X̄/unit Σ	10	100	6	140	280	15	457	88 plan	43 fan	41	11	22 Thais 1 Tig 1 Magnit
		size												
10 alternatem²		change												
1971	8/6	X̄/unit Σ	7	2	0	2077	≥1710	1141	233	111 plan 5 scut	15 de fan	424 egg	0 N 21	13 Thais 50 Chth 10 Ciri 1 Zidgy 1 Tone
		size												
8 alternative m²		change												
		X̄/unit												
		size												
		change												
		X̄/unit												
		size												
		change												
		X̄/unit												
		size												
		change												
		X̄/unit												
		size												
		change												
		X̄/unit												
		size												
		change												
		X̄/unit												
		size												
		change												
		X̄/unit												
		size												
		change												
		X̄/unit												
		size												
		change												

BR-3
p1

TRANSECT WORKSHEET - G. Chan
January, 1971

Study Site BIRD ROCK

Area____ Section____ Channel____

Transect BR-3 Type________

Other________

Reference________

Investigator________

For the organism count of each species found, give total number alive and total number dead. If any shells have oil, give number with letter S in parentheses, e.g., (7S).

Year 1970 Date 6/24 Tide/Time -0.5 Water temp.____ Other________

Plot #	Oil?	Algae, other	Pedy Live	Pis Dead	Pag Size	Myt Live	Bal Dead	Poly Size	Teg Live	Thais Dead	Litt Size	Antho Live	Stron Dead	Acan Size
1			1			0	0		0		0	0		0
3		1 Migriopus, 1 magnitas	1			0	20		0		20 plan	0		0
5			0			0	50		0		8 plan	0		0
7			0			0	50		27f		0	0		0
9			1		90s	13	0		140f		0	32 plan		0
11			2			14	0		70f	4	60 plan	0		13
13			2	2 Pis		5	50		150f			0		0
15		1 Pugettia	0		25 6h	60	0	7	64f	11		62 plan	11	0
17			3	2		48	60	8		3		6		23
19		1 Cancer	0	2			50			4		52 plan		5
			10 Pedy	6 Pis	98	140	280	15	451	22	88	43	11	41

Year 1971 Date 8/6 Tide/Time________ Water temp.____ Other________

Plot #	Oil?	Algae, other	Pedy Live	Pis Dead	Pag Size	Myt Live	Bal Dead	Poly Size	Teg Live	Thais Dead	Litt Size	Antho Live	Stron Dead	Acan Size
1			0		0	0	0		0		9 plan	0		1 scut
3		1 Lidgya 1 Mori 450 Chth	3		0	6	110		5f		24 plan, 1 scut	7 plan		91 app
5		10 Cirriformia Chitin 17/dm²	3		1	30	8/dm² ~800		187f	6	70 plan	3 plan		119 app
7			1 Nemi			0	100		3f		8 plan, 4 scut			105
9						43	700	71	27f	3				80
11						950		121	0	4				24
13						1048	yes	949	0					
15	3	Idothea, 1 Mop mus			1				11f			5 sel plan		4
17		NO COUNT				2077	1710	1141	183	13	111 plan 5 scut			424
19														

DATA SUMMARY for Study Site BIRD ROCK Transect 9-4 (BR-4) Oil? N n=____ p. 1

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

4 directional transects

Year	Date	Organisms	Haliotis rufescens per m²	Strongylo per m²	per	per	per	per
1970	6/24	X̄/unit	2.2	15.9				
		Σ	45	318				
		size						
n=20		change						
1971	5/14	X̄/unit	0.5	16.4				
		Σ	10	328				
		size		(100 purple)				
n=20		change						
1971	8/6	X̄/unit	0.3	2.9				
		Σ	6	58				
		size						
n=20		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						

DATA SUMMARY for Study Site DOUBLE POINT Transect ~~10-2~~ 10-1 Oil? N n= 20? p. 1

DP-2 outtidal

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

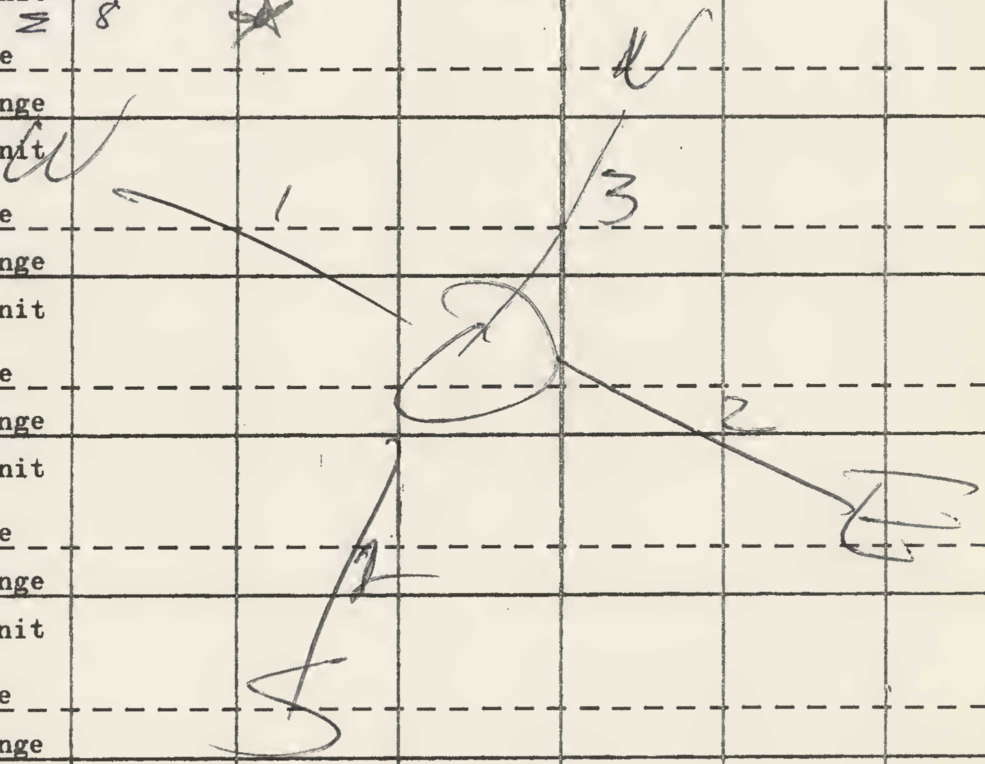
Year	Date	Organisms	*Haliotis rufescens* per	*Strongylo* per	per	per	per	per
		$\bar{X}$/unit						
		size						
		change						
1971	7/27	$\bar{X}$/unit	4	~~4~~				
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit	3		1			
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						

DATA SUMMARY for Study Site *DOUBLE POINT* Transect *10-1* Oil? *N* n= *20 m* p. *1*

DP-1 subtidal

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	*Haliotis rufescens* per	*Strongylo* per	per	per	per	per
		$\bar{X}$/unit						
		size						
		change						
1971	*7/27*	$\bar{X}$/unit	*0.4*					
		Σ size	*8*	*✱*				
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						
		$\bar{X}$/unit						
		size						
		change						



SR-1

DATA SUMMARY for Study Site *Split Rock* Transect *SR-ST-1* Oil? _____ n= ~~[illegible]~~ *10,* p. *1*

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Haliotis rufescens & Strongylocentrotus spp.

Year Date	Organisms	North HAL per	North STR	West HAL per	West STR	South HAL per	South STR	East HAL per	East STR	TOTAL per	$\bar{X}$ per
	$\bar{X}$/unit										
	size										
	change										
	$\bar{X}$/unit										
	size										
	change										
	$\bar{X}$/unit										
	size										
	change										
1971 11/7	$\bar{X}$/unit Σ	0	0	0	0	0	0	0	0	0 0	none (5 to 6 HAL on face of rock)
full transect count (10 m²) for 40 m² total	size										
	change										
	$\bar{X}$/unit										
	size										
	change										
	$\bar{X}$/unit										
	size										
	change										
	$\bar{X}$/unit										
	size										
	change										
	$\bar{X}$/unit										
	size										
	change										
	$\bar{X}$/unit										
	size										
	change										
	$\bar{X}$/unit										
	size										
	change										

SR-2

DATA SUMMARY for Study Site *Split Rock* Transect *SR-ST-2* Oil? ____ n=[illegible] p. *1*

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Organisms: *Haliotis rufescens*

Year	Date		per	per	per	per	per	per
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
1970	~~7/6~~ 7/6	X̄/unit	2 grazing ½ distance up rock 2 in depression core 4 right side depression 2 habitat scars					
		size						
		change	12					
1971 North side of rock	11/7	X̄/unit	13 in positions of 1970 grazers in habitat niches 7 additional ones found at base of rock, well established					
		size						
		change	20					
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						
		X̄/unit						
		size						
		change						

DATA SUMMARY for Study Site *Big Pipe Reef* Transect *BP-ST-*____ Oil? ____ n= ~~*subtidal*~~. *1*

L= live
D= dead; += scars
S= oil on shells
T= on top of oil
N= no oil on shells

Year	Date	Organisms	*Haliotis rufescens* ~~*sex + length*~~ *sex* per	$\overline{X}$ *length* per	$\overline{X}$ *rings* per	*color* per	per	per
		$\overline{X}$/unit						
		size						
		change						
		$\overline{X}$/unit						
		size						
		change						
		$\overline{X}$/unit						
		size						
		change						
1971	*11/2*	$\overline{X}$/unit	*2M, 3F*	*7 5/8"*	*13.5* *for 4 Hal*	*5 white*		
		size						
		range ~~change~~		*7"–8"*	*10"–19" one scarred*			
		$\overline{X}$/unit						
		size						
		change						
		$\overline{X}$/unit						
		size						
		change						
		$\overline{X}$/unit						
		size						
		change						
		$\overline{X}$/unit						
		size						
		change						
		$\overline{X}$/unit						
		size						
		change						
		$\overline{X}$/unit						
		size						
		change						

Dark ink items are represented by typewriting in the samples below; pencil items (statistics) are represented by handwriting.

DATA FILE CARD

8/9/71 DX-BT-1
2-1 N

m^2	oil	Tegula funebralis	Anthopleura elegantissima	Acanthina spirata
1	N	58	2	
2		14	35	
3		8	16	
4		20	36	
5		21	6	
6		22	12	
7		36	10	
8		29	8	
9		22	7	
10	N	20	9	1
Σ 392		250	141	1
$\bar{X}$ 39.2		25.0	14.1	0.1

COMPUTER FILE CARD

2-1 N 8/9/71 DX-BT-1

m^2	oil	TEG	AEL	$(TEG)^2$	$(ALL)^2$	$(-TEG)^2$
1	N	58	2	3364	3600	4
2		14	35	196	2401	1225
3		8	16	64	576	256
4		20	36	400	3136	1296
5		21	6	441	729	36
6		22	12	484	1156	144
7		36	10	1296	2116	100
8		29	8	841	1369	64
9		22	7	484	841	49
10	N	20	9	400	841	81
391		250	141			
152,881		62,500		7970	16765	3255

DATA CARD - main card with m^2 counts recorded:

3.3 ++++ SEE ATTACHED CARD for BAL, TEG, thais and MYT LIVE DUXBURY REEF

DX-CT-4 DATA

7/21/71 oil	m^2	Mytilus californianus	Pollicipes polymerus	Acmaea spp	Littorina scutulata	Other
+++	1 =	4DS	4	100	0	1 Pachygrapsus crassipes
++	2 =	0D	2	155	0	
+++	3 =	0D	0	200	0	
+++	4 =	0D	0	90	0	2 Cancer antennarius
N	5 =	0D	0	85	910	
++	6 =	20DS	0	30	1020	
+++	7 =	0D	100	850	0	1 Hemigrapsus nudus
N	8 =	6DS	9	50	80	
+++	9 =	0D	5	40	270	1 Hemigrapsus nudus
+++	10 =	4DS	5	30	35	

Back side of main Data Card contains other transect information:

(back side of DATA card)

Counts taken on 7/21/71 -1.2 LL @ 5:54 AM, 15° C water
7/22/71 -1.0 LL @ 6:36 AM,
7/23/71 -0.8 LL @ 7:12 AM, 13.5°C water, 11.8°C air

Porphyra in m^2 # 1,3,4,5,7-10
Gigartina in # 2,4,5,8-10
Endocladia in # 4,5-7,10
Ulva in # 9,10

All dead Balanus were covered with oil
Mytilus = 90 mm avg., Pollicipes = 70-100 mm, mostly 70 mm.
Acmaea = 10-12 mm, Littorina = 3-5 mm
Balanus = 2-6 mm, Tegula = 10-20, mostly 15 mm

Small mussels not seeded. Normal algae growth compared to immediate area was not present.

DATA CARD – supplementary card with dm^2 counts recorded: stapled to main card

3.3++++ Dm^2 COUNTS DUXBURY REEF

7/21/71 DX-CT-4 DATA

oil	dm^2	MYT LIVE only	BAL L, D	TEG	*Thais emarginata*	dm^2
↑ (not recorded)	1 =	19 (6S)	20, 11S	6	1	13 =
	2 =	17 (5S)	22, 8S	4	0	14 =
	3 =	17 (5S)	30, 7S	6	0	15 =
	4 =	17 (4S)	22, 4S	0	1	16 =
	5 =	17 (2S)	12, 0D	0	1	17 =
	6 =	14 (2S)	10, 0D	1	3	(etc)
	7 =	12 (2S)	9, 10S	3	1	
	8 =	14 (3S)	6, 9S	6	3	
	9 =	13 (4S)	24, 11S	5	2	
	10 =	16 (5S)	26, 12S	2	3	
	11 =					
	12 =					

STAT CARD – statistical analyses of selected species:

3.3 STATS $n = 10\ m^2$ DUXBURY REEF

7/21/71 DX-CT-4

	MYT L (dm^2)	MYT D	POL	BAL (dm^2)		Other species present:
Σ =	1521 (291S)	34	125	983L,	1002DS	
$\Sigma(y^2)$ =	25559	468	10151	14245,	38100	
S.D. =	4.9	6.3	30.9	6.8,	16.8	TEG
$\bar{X}$ =	15.2 (2.9S)	3.4	12.5	9.8,	10.0	ACM
μ =	14.2 to 16.2	-1 to 7	-9.6 to 34.6	8.5 to 11.2,	6.7 to 13.3	LIT
$\hat{p}, \hat{q}$ =	(19.1% S)			49.5%	50.5%	Thais
p, q =	(17.2 to 21.1% S)			47.3-51.7%	48.3-52.7%	PAC
						CAN

TRANSECT WORKSHEET DATA

Dr. G. Chan
Rev. 7/1972

NOTE: Persons working on berm should use berm worksheets, then summarize data on transect worksheet. All worksheets should be submitted with the written report.

N = no oil
+ = 1-25%
++ = 26-50%
+++ = 51-75%
++++ = 76-100%

1. Amount of oil for each square meter and each square decimeter sample plot is recorded in terms of one plus sign (+) for each 25% coverage. ⟶

2. Counts of live and dead are recorded in separate columns. Counting instructions are given in handout "Transect Sites for Oil Spill Study" and in large pink binder, marked "Transect Studies".

   Square decimeter sampling counts, 10 dm^2 counts in each m^2, are individually recorded on a decimeter worksheet; also the oil coverage in each dm^2. DO NOT DISCARD these dm^2 counts! Do not "mix" m^2 counts with dm^2 counts of same species.

3. All organisms are assumed to have no oil or not be on oil unless indicated by:

   S = oil on organisms (organisms not on top of oil)
   ST= oil on organisms, organisms on top of oil
   T = organisms on oil (no oil on organisms); T is used mainly for live mobile organisms, to determine if they "avoid" oil spots or not.
   Example: 24 (6S,2ST) = total of 24; 6 of these 24 had oil, 2 of them had oil,on oil

4. Size of organisms for transect as a whole, for each species. Record average if size is fairly uniform. For great diversity in size, give range in mm for young organisms and range for adult organisms, and the density counts (or percentage) for each of the two groups.

5. Summarize transect data at bottom of each column by totaling columns and S,ST,T.

6. Algae,other: record growth of algae. Make note of other conditions of interest, such as oil deposits, clustering of organisms, significant nurseries, etc.

- -

TRANSECT REFERENCE FILE (TREF)

TREF = A three-file reference storage of all transect data and statistical analyses recorded on 4" x 6" index cards. Each transect count appears on three cards:

Data File Card contains all data information from worksheet
Stat File Card contains analysis of selected data
Control File Card contains log of total transect counts

SEE attached pages 2 and 3 for sample cards.

SPECIES CODE for STAT and CONTROL CARDS:

TEG	Tegula funebralis
ACM	Acmaea scabra, A. digitalis
LIT	Littorina scutulata
ACA	Acanthina spirata
MYT	Mytilus californianus
POL	Pollicipes polymerus
BAL	Balanus glandula, C. dalli
MOP	Mopalia muscosa
PLA	Platyodon cancellatus
AST	Pisaster ochraceus
AXA	Anthopleura xanthogrammica
AEL	Anthopleura elegantissima
STR	Strongylocentrotus purpuratus
HAL	Haliotis rufescens
PAC	Pachygrapsus crassipes, Hemigrapsus nudus
CAN	Cancer antennarius, Pugettia producta, Pagurus samuelis
EME	Emeritus analoga
NEP	Nephtys californiensis
ORC	Orchestoidea californiana

DATA CARD - main card with m^2 counts recorded:

3.3 ++++ SEE ATTACHED CARD for BAL, TEG, thais and MYT. LIVE DUXBURY REEF

DX-CT-4 DATA

7/21/71		Mytilus	Pollicipes	Acmaea	Littorina	
oil	m^2	californianus	polymerus	spp	scutulata	Other
+++	1 :	4DS	4	100	0	1 Pachygrapsus crassipes
++	2 :	0D	2	155	0	
+++	3 :	0D	0	200	0	
+++	4 :	0D	0	90	0	2 Cancer antennarius
N	5 :	0D	0	85	910	
++	6 :	20DS	0	30	1020	
+++	7 :	0D	100	850	0	1 Hemigrapsus nudus
N	8 :	6DS	9	50	80	
+++	9 :	0D	5	40	270	1 Hemigrapsus nudus
+++	10 :	4DS	5	30	35	

Back side of main Data Card contains other transect information:

(back side of DATA card)

Counts taken on 7/21/71 -1.2 LL @ 5:54 AM, 15° C water
7/22/71 -1.0 LL @ 6:36 AM,
7/23/71 -0.8 LL @ 7:12 AM, 13.5°C water, 11.8°C air

Porphyra in m^2 # 1,3,4,5,7-10
Gigartina in # 2,4,5,8-10
Endocladia in # 4,5-7,10
Ulva in # 9,10

All dead Balanus were covered with oil
Mytilus = 90 mm avg., Pollicipes = 70-100 mm, mostly 70 mm.
Acmaea = 10-12 mm, Littorina = 3-5 mm
Balanus = 2-6 mm, Tegula = 10-20, mostly 15 mm

Small mussels not seeded. Normal algae growth compared to immediate area was not present.

DATA CARD - supplementary card with dm^2 counts recorded: stapled to main card

3.3++++ DM^2 COUNTS DUXBURY REEF

7/21/71 DX-CT-4 DATA

til (not recorded)	dm^2	MYT LIVE only	BAL L, D	TEG	Thais emarginata
	1 =	19 (6S)	20, 11S	6	1
	2 =	17 (5S)	22, 8S	4	0
	3 =	17 (5S)	30, 7S	6	0
	4 =	17 (4S)	22, 4S	0	1
	5 =	17 (2S)	12, 0D	0	1
	6 =	14 (2S)	10, 0D	1	3
	7 =	12 (2S)	9, 10S	3	1
	8 =	14 (3S)	6, 9S	6	3
	9 =	13 (4S)	24, 11S	5	2
	10 =	16 (5S)	26, 12S	2	3
	11 =				
	12 =				

dm^2
13 =
14 =
15 =
16 =
17 =
(etc)

STAT CARD - statistical analyses of selected species:

3.3 STATS n = 10 m^2 DUXBURY REEF

7/21/71 dm^2 dm^2 DX-CT-4

	MYT L	MYT D	POL	BAL
Σ =	1521 (29 S)	34	125	98 3L, 100 2DS
$\Sigma(y^2)$ =	25559	468	10151	14245, 38100
S.D. =	4.9	6.3	30.9	6.8, 16.8
$\bar{x}$ =	15.2 (2.9S)	3.4	12.5	9.8, 10.0
μ =	14.2 to 16.2	-1 to 7	-9.6 to 34.6	8.5 to 11.2, 6.7 to 13.3
$\hat{p}, \hat{q}$:	(19.1% S)			49.5% 50.5%
p, q :	(17.2 to 21.1% S)			47.3-51.7% 48.3-52.7%

Other species present:
TEG
ACM
LT
Thais
PAC
CAN

TRANSECT REFERENCE FILE (TREF)

Dr. G. Chan
2/1972

Transect Data - each and every m^2 or dm^2 count for each species for a specific transect. These counts and other observations regarding algae, residual oil, size of species, etc. are recorded on transect worksheets.

Transect Count - data gathered for one complete count on the transect, e.g., "the April 2-3, 1971 count".

TREF - A three-file reference storage of all transect data on 4" x 6" index cards. Each transect count appears on three cards, one for each file:

Data File Card contains all data from worksheet (one card/transect count)
Computer File Card contains selected data for input (one card/transect count)
Control File Card contains summary, a data log of total counts only for each species (one line on card/transect count)

ITEM LIST for TREF CARDS - Data is more easily scanned when recorded in a consistent manner. Enter all items below in black or blue ink unless otherwise indicated. You will record on Data and Computer File cards only.

ITEM	DATA CARD	COMPUTER CARD
Front side of card (lined)		
1. Transect # (DX-BT-1)	Upper right space	(same)
2. Computer file #(2-1)	GREEN ink under Tr #	Upper left space in GREEN
3. Transect Oil(N,+'s)	RED ink after computer #	(same)
4. Date (7/23/71)	Upper left	after TR oil
5. m^2#, +	list in column	(same)
dm^2#, +	check Control File, see me.	OMIT
6. Species	list each sp. and count	use Species Code in order given, check Control File
7. Counts	All counts are assumed live; note dead counts with a D. Record dm^2 counts on 2nd card for Data File only.	
8. Statistics USE PENCIL	See sample cards on next page.	
	Each species Σx_i, $\bar{X}/m^2$	Σx_i For TEG only= x_i^2, $\Sigma (x_i)^2$, and $(\Sigma x_i)^2$
	All species together Σx_i, $\bar{X}/m^2$	Σx_i, $(\Sigma x_i)^2$ For each m^2= x_i^2, $\Sigma(x_i)^2$, also (-TEG)

9. Back side of card (blank) for Data File only. Tide/time, weather, air-water temp, unusual+ usual, size of species, S,ST,T data, etc.

SPECIES CODE for Computer

TEG	Tegula funebralis
ACM	Acmaea scabra, A. digitalis
LIT	Littorina scutulata
ACA	Acanthina spirata
MYT	Mytilus californianus
POL	Pollicipes polymerus
BAL	Balanus glandula, C. dalli
MOP	Mopalia muscosa
PLA	Platyodon cancellatus
AST	Pisaster ochraceus
AXA	Anthopleura xanthogrammica
AEL	Anthopleura elegantissima
STR	Strongylocentrotus purpuratus
HAL	Haliotis rufescens
PAC	Pachygrapsus crassipes, Hemigrapsus nudus
CAN	Cancer antennarius, Pugettia producta, Pagurus samuelis
EME	Emeritus analoga
NEP	Nephtys californiensis
ORC	Orchestoidea californiana

Other species= OMIT for Computer File, but list in single column for Data File.

TRANSECT WORKSHEET DATA

Dr. G. Chan
Rev. 2/1972

NOTE: Persons working on the berm should use the berm worksheet, then summarize data on a transect worksheet.

1. Amount of oil is recorded in terms of one plus sign (+) for each 25% coverage:

m^2 oil	dm^2 oil	transect oil for 10 m^2 (record in red ink next to transect number)
+ = 1-25%	same as m^2	+ = 1 or 2 m^2 with oil
++ = 26-50%		++ = 3, 4, or 5 m^2
+++ = 51-75%		+++ = 6 or 7 m^2
++++ = 76-100%		++++ = 8, 9, or 10 m^2
N = no oil		N = no m^2 with oil

2. Count of live and dead appears in separate columns. If there are more than four species found consistently in most of the m^2, use extra worksheet space. Use a single column for "other" species, small counts, only a few m^2, and write in species name beside the count.

   In some transects, not all species are counted, some species are noted as present with a * in the appropriate m^2 spaces. Check with me or previous transect count data, or control file card.

   Dm² sampling is restricted to very dense populations of Mytilus californianus, Littorina scutulata, or Balanus glandula and Chthalamus dalli combined. Check *the control filecard for the transect to determine if you should sample by dm^2. Take 10 dm^2 counts in each m^2. On the back of your worksheet, record every dm^2 count, indicating m^2 in which samples are taken, and amount of oil on the dm^2. On the front side of worksheet, underline this species name with red ink, also the note "10 dm^2/m^2". Record in the live and dead columns the total count for the 10 dm^2 for that m^2. At the bottom of the columns give the total count for the 100 dm^2. (DO NOT estimate total population in the transect.)

3. All organisms are assumed to have no oil or not be on oil unless indicated.

   S = oil on organisms (organisms not on top of oil)

   ST = oil on organisms, organisms on top of oil

   T = organisms on top of oil (no oil on organisms)

   The count of such organisms should be placed in parentheses with appropriate code letter after the total count for the m^2, e.g., 24 (16S, 2ST) shows a total count of 24; 16 of the 24 had oil on their shells, 2 of the 24 had oil on them and also lived on top of oil.

   Dead organisms with oil are assumed to be surrounded and trapped by oil- make note of any exceptions. T is used mainly to determine if live mobile organisms "avoid" oil spots or not; do not use T for sessile organisms.

4. Size of organisms: record average size if size is fairly uniform. If there is great diversity in size, give the range in sizes as well as the average.

5. Summarize transect data at the bottom of each column by totaling live and dead counts, computing the mean count per square meter (do not compute mean for dm^2 sampling on this worksheet), and totaling the S, ST, T figures.

6. Algae, other: record unusual, usual growth of algae. Make note of any specific conditions of interest, particularly in regard to oil deposits, clustering of organisms, significant nurseries. This space may be used to record diversity range in size of organisms.

*Handout sheet "Transect Sites for Oil Spill Study" also has this information.

Dark ink items are represented by typewriting in the samples below; pencil items (statistics) are represented by handwriting.

DATA FILE CARD

8/9/71 DX-BT-1 2-1 N

m^2	oil	Tegula funebralis	Anthopleura elegantissima	Acanthina spirata
1	N	58	2	
2		14	35	
3		8	16	
4		20	36	
5		21	6	
6		22	12	
7		36	10	
8		29	8	
9		22	7	
10	N	20	9	1
Σ 392		250	141	1
$\bar{X}$ 39.2		25.0	14.1	0.1

COMPUTER FILE CARD

2-1 N 8/9/71 DX-BT-1

m^2	oil	TEG	AEL	$(TEG)^2$	$(ALL)^2$	$(-TEG)^2$
1	N	58	2	3364	3600	4
2		14	35	196	2401	1225
3		8	16	64	576	256
4		20	36	400	3136	1296
5		21	6	441	729	36
6		22	12	484	1156	144
7		36	10	1296	2116	100
8		29	8	841	1369	64
9		22	7	484	841	49
10	N	20	9	400	841	81
391		250	141			
152,881		62,500		7970	16765	3255

1/18/71
ALL SITES

TIME LOG FOR ALL STUDY SITES

Year	Date	Tide, Time	Area, Sect.	Tran-sect	General Observations

9/78
mchan

BASIC MONROE #1785 PROGRAM
for monthly income & expenses

ID (reg 0), STARTING BALANCE (reg 1)
ADD, SUB-TOTAL, SUBTRACT, NET TOTAL, BACK to BRANCH PT [0]

TO OPERATE
MANUAL: RESET, ENTER STARTING BALANCE, STORE ↓[1]

TO LOAD PROGRAM
TO (0) LOAD:

ID ↑[0] −1 = PR ENT ↓[0]

↑[1], PR ENT, + (HALT) PR ENT, = PR ANS, (↑ +[2])

− (HALT) PR ENT (↑+[3]) = PR ANS (*) ↓[1] TO (0)

(*) either DEBT SERVICE single entry in December or #13 month

OR (*) for DEBT SERVICE, INSERT:
− (HALT) PR ENT = PR ANS ↓[1] TO (0)

WRITTEN PROGRAM, ADD JUMP to BRANCH PT. print ↑[2] PR ENT, ↑[3] PR ENT

---

for constant (total expenses) — enter $ in ↓[2]

↑[0] −1 = PR ENT ↓[0]

↑ [1], PR ENT, + (HALT) PR ENT = PR ANS

− ↑[2] PR ENT = PR ANS ↓[1] TO (0)

CALIFORNIA Sea Grant

Marine Advisory Publication

Intertidal Zonation

Intertidal zonation is a good way to gain a deeper understanding of the ecology and uniqueness of the intertidal environment. By performing the relatively detailed study described, you can form a clearer concept of the distribution of the intertidal plants and animals and how they have adapted to the intertidal environment. A basic statistical analysis you can use in your study is also described.

Activity Outline

Identify intertidal organisms. Study the biology of some of the more common invertebrates and/or algae found in the intertidal zone. Use the references in this guide, the references listed in the *Marine Science Bibliography*, AXT—438-7, and any other references available. For assistance, you can also contact local people who are knowledgeable in marine science (college instructors, advanced students, Fish and Game employees, others). Learn to quickly identify the common intertidal organisms. Several trips to the coast will help greatly.

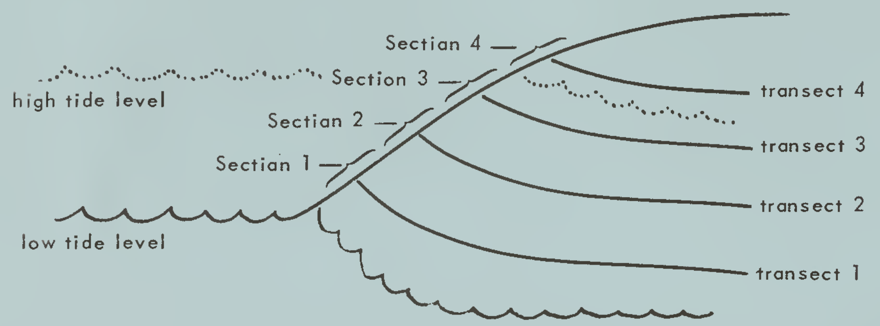
Materials. For this activity, you need a clipboard, paper, pencil, and a ¼-inch-wide line (rope, clothes line, etc.) that is 32 feet, 9½ inches long (10 meters—use the metric system whenever possible). To make your trip more comfortable, wear warm clothes and boots. Also take along identification books or keys. **Do not collect any organisms from the tide pools.** Check the *Sport Fishing Regulations* carefully before you go to the coast.

Select a site. Go to the beach at low tide, preferably a minus tide, and look for a rocky reef area that appears to have a diverse flora and fauna. Ask knowledgeable local people where good sites might be found. (Also consult the references for ideas, especially pages 336 to 387 in Light's book.) Be sure you can easily locate the site again for later studies. Carefully study the area. Note the environmental factors—human or otherwise—that affect the study area. Observe the incoming tide. Where does it reach first? Are there fresh-water streams in the area? Signs of pollution? Signs of heavy use by people?

COOPERATIVE EXTENSION UNIVERSITY OF CALIFORNIA

AXT—445-10
10/74

Set up transects. Divide your site into four more or less equal sections. Start far out on the reef in the area exposed by low tide and end at the uppermost part of the reef where only an occasional wave splashes at high tide.



Set up a transect in each of the four sections. You can set up a transect by laying out the 10-meter-long line parallel to the ocean. For each transect, identify, count, and record all of the animals and/or algae that come in contact with the line. You will not be able to identify all the organisms you find, but try to recognize the most common ones.

Organize data. Tally up the numbers of each species in each transect and organize them so that you can compare the four sections. Are there large differences in the numbers and kinds of species in each section? Why? How is the environment different in each section? Look carefully at the different species. In what ways have they adapted to the intertidal environment? What effects do wave action and sunlight have on the distribution of species in this area?

Ideas for further study. When you compare the data for the four sections, it may appear that the numbers of some species are different in each section. Such differences may actually exist or they may be due to chance. To be able to say scientifically that there **is or is not** a significant difference in the numbers of a species (mussels, algae, other) among the different sections, you must use statistical analysis.

For this activity, you can use a simple test called the chi-square (X^2) test. To understand how to perform a chi-square test, refer either to a beginning statistics book or ask your math teacher. (See the example of a chi-square test for mussels.) If you learn to correctly use statistics, you might be able to say that, for example, there is a 95% probability that the difference between the number of mussels in the first and third sections **is not** due to chance. By doing more transects in each section, you can make a more reliable analysis.

As another part of this project, you might want to study the four sections throughout the year to see if there are any seasonal differences in species distribution or population size. What would cause this kind of change? Weather? Oceanic conditions? Or you could concentrate on the year-round movements and population changes of one or two species (snails, sea urchins, starfish, or other). This would give you a good understanding of the organism's niche (the function that the organism fulfills in its natural community, such as primary producer, first-order consumer, scavenger).

If you want, make a map of your study area. On this map, you could use colors to show the distribution of the common species of animals and/or algae. A colored topographic map would be even better since it would show the effect of altitude on species distribution. Use your imagination—an important tool of science.

Example of Chi-Square (X^2) Test for Mussels

Let's look at an example of how to do a chi-square (X^2) test to compare transect counts of mussels.

After laying out four transects—one transect in each of the four sections on your reef site—you count 8 mussels in transect 1, 22 mussels in transect 2, 23 mussels in transect 3, and 11 mussels in transect 4. When you first compare the four transects, it appears that there is a real difference between the numbers of mussels in each transect. But how can you be sure? Perhaps the difference is only due to chance. By using the chi-square (X^2) test, you can find out whether there is a real difference between the transects or whether the difference is due to chance.

The formula for chi-square (X^2) is:

$$X^2 = \frac{[\text{observed value (O)} - \text{expected value (E)}]^2}{\text{expected value (E)}}$$

Transect	Mussels Observed (O)	Mussels Expected (E)	(O - E)	$(O - E)^2$	$\frac{(O-E)^2}{E}$
	(number)				
1	8	16	-8	64	4.0
2	22	16	6	36	2.3
3	23	16	7	49	3.1
4	11	16	-5	25	1.6
TOTAL	64	64			X^2 = 11.0

Procedure

1. List observed value (O).
2. Determine the number of mussels expected (E). For example, if mussels were distributed equally throughout your four sections, then you would expect equal numbers in each transect. Thus, to obtain the expected value (E) for each transect, divide the total number of mussels observed (64 mussels) by 4 (four transects). This gives:

$$E = \frac{64}{4} = 16 \text{ mussels per transect.}$$

3. Calculate O - E.
4. Calculate $(O - E)^2$.
5. Calculate $\frac{(O - E)^2}{E}$.
6. Total all the $\frac{(O - E)^2}{E}$ values. This gives you an X^2 value of 11.0.
7. Calculate the "degrees of freedom" (d.f.). You can find the degrees of freedom by adding the number of transects (four) and then subtracting one transect. This gives:

$$4 \text{ transects} - 1 \text{ transect} = 3 \text{ degrees of freedom.}$$

8. Use a table of "Percentage Points of the X^2 Distribution" (found in statistics books) and look at the row for 3 degrees of freedom to find the table value closest to, but not exceeding, your X^2 value of 11.0. Then determine which percentage (%) column this value lies within.

Percentage Points of the Chi-Square (X^2) Distribution

d.f.	percentage (%)								
	95	90	75	50	25	10	5	2.5	1
1	—	0.016	0.102	0.455	1.32	2.71	3.84	5.02	6.63
2	0.103	0.211	0.575	1.39	2.77	4.61	5.99	7.38	9.21
3	0.352	0.584	1.21	2.37	4.11	6.25	7.81	9.35	11.3
etc.									

In our example, 9.35 is the largest table value for 3 degrees of freedom that does not exceed our X^2 value of 11.0. This 9.35 value is found under the 2.5% column. The 2.5% value indicates that there is less than a 2.5% probability that the differences in the number of mussels among the transects are due to chance. In other words, you would be correct 97.5% (100% - 2.5%) of the time in saying that a **significant difference** exists between the number of mussels in one or more of the transects and the remaining transects.

Scientists usually consider a **significant difference** to exist if the probability is 5% or less that the difference is due to chance. In our example, the probability that the difference in the number of mussels is due to chance is only 2.5%. Since this is less than 5%, we can indeed consider that a significant difference exists between the number of mussels in one or more of the transects and the remaining transects.

How does all this relate to intertidal zonation? By setting up transects in each of the four sections of your rocky reef site, and by subsequently performing a chi-square test, you have shown that a **real difference** exists in the number of mussels among sections in this example. In other words, you have shown that more mussels live in some sections than in others. If you consider each of your four sections as intertidal zones, then you have shown that more mussels live in some zones of the intertidal area than in others.

NOTE: You can do chi-square tests to compare any two, three, or all four of the transects. For example, here is a chi-square test that compares two transects, transects 2 and 3.

Transect	Mussels Observed (O)	Mussels Expected (E)	(O - E)	$(O - E)^2$	$\frac{(O - E)^2}{E}$
	(number)				
2	22	22.5	- 0.5	0.25	0.01
3	23	22.5	0.5	0.25	0.01
TOTAL	45				X^2 = 0.02

$$E = \frac{\text{total number of mussels observed}}{\text{number of sections}} = \frac{45}{2} = 22.5.$$

$$\text{d.f.} = \text{total number of sections} - 1 \text{ section} = 2 - 1 = 1.$$

Use a table of "Percentage Points of the X^2 Distribution" to find the largest table value for 1 degree of freedom (d.f.) that does not exceed the X^2 value of 0.02. This value is 0.016 and is found under the 90% column. Thus, there is a 90% probability that the difference in the number of mussels between transects **is due to chance**. Since this 90% probability greatly exceeds the 5% probability level used by scientists to determine if a significant difference exists, we can conclude that a **significant difference does not exist** in the number of mussels between transect 2 and transect 3.

GLOSSARY

Intertidal zone — area between the highest high tide and the lowest low tide.

Ecology — relationships between plants and animals and their environment.

Environment — all the things (conditions, circumstances, and influences) that surround and affect organisms.

Biology — study of the physical characteristics, habits, etc. of plants and animals.

Invertebrate — an animal that has no backbone. This group includes all animals except fishes, amphibians, reptiles, birds, mammals.

Flora — plant life.

Fauna — animal life.

Reef — a large ridge of rocks at or near the surface of the water.

Organism — any living thing.

Species — a population or group of distinct organisms that have some common characteristics and are reproductively isolated from other distinct organisms.

Scavenger — an animal that eats decaying matter or refuse.

Topographic map — a map that shows the surface features of an area, such as hills and valleys.

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